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EDITORIAL

When tuberculosis occurs in association with another malady it is often a matter of great import for the prognosis and treatment of both conditions. Nowhere is this more evident than in the association of pulmonary tuberculosis and diabetes mellitus. That this is not infrequent and that it carries serious risks are generally admitted; yet beyond these broad facts we are still largely ignorant of the exact conditions in which the association becomes more frequent than chance allows, and in which it comes to have such a sinister reputation.

The literature on these problems has recently been reviewed,* and fresh evidence produced which throws a good deal of light upon several points hitherto obscure. Autopsy statistics show that active pulmonary tuberculosis is common in diabetics; and clinical impressions suggest that it usually appears suddenly and progresses rapidly. This means either that the diabetic is unusually prone to the disease, or that the latter begins insidiously and deeply in the lung, remaining undetected until far advanced. If the former of these two alternatives is correct the prospect of reducing the mortality from pulmonary tuberculosis in diabetics is remote, apart from what can be achieved by preventing the risk of exposure to infection; on the other hand, if the latter is the true explanation of the alleged character of the disease in diabetics, then earlier diagnosis offers hope of much more successful treatment. Himsworth points out that to know which of the two alternatives is correct we need to know the incidence rate of pulmonary tuberculosis in diabetics when the diagnosis is made by clinical means and when radiology is used

* Himsworth, H. P.: *Quart. Journ. Med.*, 1938, N.S. VII., 373.

only to confirm or refute a clinical opinion; the incidence rate when every new case of diabetes is examined radiologically as a routine; the incidence rate in efficiently treated patients in whom radiological examination has excluded the presence of tuberculosis when these patients first came under treatment; and also the course of pulmonary tuberculosis in treated diabetics.

Evidence shows that the clinical incidence of the disease among diabetics ranges from 1 to 5½ per cent., averaging about 2½ per cent. There is little knowledge of the incidence as assessed radiologically; Kennedy found 1·6 per cent., Sosman and Steidl 9 per cent., but these figures do not refer to new cases. Himsworth found radiological lesions at the time of the patient's first attendance in fifteen (6·5 per cent.) of two hundred and thirty consecutive cases. Eight of these had definite active disease, and the remaining seven minimal infiltrations; only two out of the fifteen had any clinical evidence of pulmonary tuberculosis, and here there was tuberculous broncho-pneumonia. In the course of the investigation no evidence was found to support the idea that there is a high incidence of pulmonary tuberculosis among efficiently treated diabetics; only two examples of early lesions have been found during a period of two years among more than three hundred diabetic patients under continuous observation. This incidence rate, approximately 0·7 per cent., contrasts with that of 6·5 per cent. found in untreated cases at their first attendance, and the conclusions seem to be that while treated diabetics are no more liable to develop pulmonary tuberculosis than non-diabetic subjects, uncontrolled diabetes has a profound effect in predisposing to the disease. The importance of early recognition by radiology and of efficient treatment of the diabetes as measures for restricting the ravages of tuberculosis among diabetic subjects is thus more clearly established.

Turning to the treatment of the combined condition, it appears that the introduction of insulin has not so far affected mortality rate to any appreciable extent. Survival for more than three years is still exceptional. Himsworth records twenty-nine patients, however, with improvement under treatment exceeding any hitherto reported; four died from acute tuberculous broncho-pneumonia and two others from progressive chronic tuberculosis, but the remaining twenty-three are alive, seven with arrested lesions now invisible radiologically, thirteen with quiescent fibrosis, one with active disease still under treatment but with a favourable response, and one with active disease that is still progressing. Admittedly these

results are helped by the inclusion of seven cases with minimal lesions, though excluding these they are still better than others in the literature.

There are believed to be two important points concerned in securing such results. The first is the use of high calorie diets, at least 2,000 calories daily, along with a high carbohydrate-low fat ratio, the usual proportion being carbohydrate 3, protein 1, fat 1, with the total amount of fat less than 100 gm. Some years ago Fisberg indicted the practice of using diets that compelled under-nutrition for these patients, and there is now general agreement that they are highly dangerous as they inevitably lead to rapid progression of the tuberculous lesion. The second point in treatment is that all these patients need insulin. The former view that insulin might have an unfavourable effect upon the disease in the lungs lacks valid support, and it should be used in amounts adequate to control the blood sugar, and also any ketonuria and glycosuria, while the patient is taking a high calorie diet. With diets ranging from 2,000 to 2,600 calories daily, doses of 10 to 20 units are usually needed three to six times daily.

From this it appears that treatment of the diabetes is the groundwork upon which success has to be based. Without this the prospect deteriorates, and however carefully a routine of rest is enforced, or with whatever skill other measures are applied, there is likely to be a steady and disappointing failure to achieve control of the tuberculosis. On the other hand, if the diabetes of tuberculous diabetics is treated efficiently there now seem to be grounds for believing that prognosis for the tuberculosis may be better than in non-diabetic subjects with comparable disease in the lungs. Uncontrolled diabetes predisposes to tuberculosis, but once this predisposition is removed by treatment the diabetic may be in a relatively stronger position than the non-diabetic. The latter acquired tuberculosis because his resistance was so poor that he developed a similar lesion, although not under the handicap of diabetes. There are, of course, sources of fallacy in such an argument, but it is a new and stimulating view, and one that suggests the approach of a much more hopeful era in our knowledge of this difficult subject.

GENERAL ARTICLES

CLINICAL ASPECTS OF PNEUMOTHORAX THERAPY AS ILLUSTRATED BY THE RESULTS OBTAINED IN 191 CASES OF COMPLETED TREATMENT

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Introduction.

This is an account of the results of pneumothorax therapy in 191 patients on whom this treatment was commenced within the period 1925 to 1931—*i.e.*, commencing at a time when roentgenography was already highly efficient and terminating five years ago. The treatment has been completed in nearly all these cases, and the patients who are still under treatment are now being treated for a relapse or for some special complications. Perhaps the objection may be made that an investigation of the fate of these 191 patients can bring nothing new, as far greater statistics on this subject have been published from other quarters. It will be appropriate, therefore, to point out why we have found this review desirable.

In discussing the clinical aspects of pneumothorax therapy the first and fundamental question is whether such treatment has any value. If Gräff had been right when he claimed that cavernous phthisis practically meant certain death, the problem would not exist. But, from numerous individual reports, we know that cavities of all types and all sizes *may* heal under conservative treatment, and as demonstrated by Cold,* this applies to about 40 per cent. of cases with cavities of recent origin. This means, in other words, that pneumothorax therapy requires statistical justification.

Here we shall not enter into the literature on this subject, but merely state that it is surprising to find how inadequately this important question has been answered so far. In trying to establish the value of an active

* *Acta Tuberculosa Scandinav.*, 11: 73. 1937.

therapy by comparing a group of cases under active treatment and a group of cases under conservative treatment, it is essential that the two groups be uniform except for the treatment. Patients treated in a private sanatorium are not comparable to the poor classes of the city, and even less comparable to the undernourished patients seen in the years after the world war. The comparison has to be made between patients who are not only at the same stage of the disease, but subject also to the same external conditions. If, for instance, pneumothorax patients have been under treatment twice as long as the others and have been confined to bed twice as long, the result obtained cannot be ascribed summarily to the pneumothorax therapy. If both groups are made up of patients from the same department, there is still the fallacy introduced by the fact that it is the more sensible and afterwards more careful patients who consent to treatment by pneumothorax. In other words, it is extremely difficult to obtain external conditions that allow of serviceable comparison.

In this respect, the Öresund Hospital (tuberculosis hospital of Copenhagen) affords a particularly favourable opportunity for comparative studies. The hospital comprises two departments, and patients come from the same locality and milieu, the poor districts of Copenhagen. In the five-year period we are dealing with, pneumothorax therapy was scarcely used at all in one of these departments, whilst in the other department this form of treatment was used in the cases included here. Cold is now working on a rather comprehensive statistical account of the group that was treated conservatively, and when this work is completed it will be possible to compare the two groups. But, whatever the result of this comparison, it is of interest to analyse the treated group, more particularly to try to elucidate whether certain types of pneumothorax have given better final results than others, and whether there are any indications for more active or less energetic treatment than that adopted at present.

The case records and X-ray plates of the 191 patients included have been analysed and questionaries sent to each patient. Of those living, only eight failed to answer our questionaries, and these from other sources are known to be well and able to work. In addition, we tried to re-examine as many as possible. It has thus been possible to establish the mortality of the series exactly, though the proportion of those living that are clinically " ill " or " well " is somewhat uncertain, as only eighty-seven of the 125 living were re-examined after 1936. Apart from the eight cases mentioned above, however, we have obtained recent detailed information in writing about all the others.

All the 191 patients had tubercle bacilli in their sputum before treatment, and the greater majority were suffering from unilateral processes

and were treated with a unilateral pneumothorax. A few patients in whom progression in the sound lung appeared subsequently were treated with pneumothorax duplex, nearly always in the form of alternating pneumothorax.

Of the total 191 patients, sixty-six have died. One died of acute nephritis, three years after the completion of pneumothorax treatment, after he had become well and able to work as a general practitioner; he has been included as "well," because there was no reason to regard the nephritis as in any way related to his tuberculosis, and it is reasonable to think that he would have been well yet but for the new disease. Among the remaining sixty-five patients, one—a man aged fifty-three—died with the clinical features of acute cardiac failure shortly after the institution of the treatment, another died of pneumonia in the sound lung after an operation for gastric ulcer, and one died from a probably non-tuberculous pneumonia of the functioning lung. Even though death in these three cases was scarcely attributable directly to tuberculosis, the pneumothorax treatment may perhaps have contributed to the fatal outcome, so that they have been included among those dying from tuberculosis.

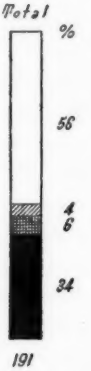

FIG. 1.—RESULTS OF TREATMENT IN ALL 191 CASES.

The basal massive part of the column represents the dead; the following cross-hatching represents the bacillary patients; the single hatching signifies the number of patients "still under treatment," but otherwise improving or well; the remaining part, in contour, signifies the number of patients without any sign of active tuberculosis after completion of the treatment.

Thus there were sixty-five "dead"—*i.e.*, 34 per cent. (Fig. 1). Eleven patients (6 per cent.) are still bacillary, and eight of these are under treatment. All these eleven patients are recorded as "ill." Eight patients (4 per cent.) are under treatment yet, but otherwise well. Finally, the treatment has been completed in 107 cases (56 per cent.) who are now free from symptoms of active tuberculosis (as mentioned, the information obtained about eight of them is somewhat defective); seven of them state that they are unable to work.

Naturally these therapeutic results depend in part upon the condition of the patients at the institution of treatment—*i.e.*, upon the indications—and partly on the course of the treatment. The therapeutic results may be poor because the physician is modest in his demands as to the condition of the patient before the institution of pneumothorax treatment (wide indications for this treatment), but also because he is modest in his demands

as to the condition of the pneumothorax, keeping up quite an incomplete pneumothorax for years. In order to judge reasonably from the results of pneumothorax treatment, it is essential, therefore, to give an account of the indications—*i.e.*, *the status quo at the institution of the treatment*, as well as the *course* of the treatment—*i.e.*, the form of pneumothorax obtained.

In the following Part I., therefore, a survey will be given of the 191 patients and the results of their treatment with reference to factors known at the institution of treatment (see Table I.). Then, in Part II. a survey will be given of these cases with reference to the anatomical character of the pneumothorax obtained (see Fig. 5). Finally, in Part III. we shall combine the various findings and compare the results when the original factors are taken into account, together with the subsequent phenomena occurring in the course of the treatment.

PART I.

In Table I. the results are recorded in relation to the *factors known at the institution of the treatment.*

Sex distribution of this material gives 61 men and 130 women. The results differ but little in the two sexes, being slightly better in the women than in the men. Also the *age* distribution, which we have limited to two groups—over and under twenty-five years—shows only a slight difference between the results in these two groups.

In patients with *disposition* to tuberculosis (*i.e.*, patients with tuberculosis in their family history) the results are a little better than in patients without disposition.

Another point that emerges is that, judging from the *duration of illness* prior to the institution of treatment, the results are slightly more favourable in those cases where pneumothorax treatment was employed as a relatively early measure. The *location* of the disease appears to have little effect. In 100 cases the lesion was on the right side and in 91 on the left side. In the right-sided the results are a little inferior to those in the left-sided.

FIG. 2.
For explanation see the legend of Fig. 1.

The condition of the other lung was found to be of essential significance (Fig. 2). In 136 cases the process was limited roentgenographically to one side; in 55 cases X-ray examination showed disease in both lungs. In thirty-six of the latter the changes in the lung that was least involved consisted in calcified foci or small sharply defined shadows that could be interpreted only as signs of processes that had

TABLE I.—SURVEY OF THE LASTING RESULTS IN RELATION TO FACTORS KNOWN AT THE INSTITUTION OF PNEUMOTHORAX TREATMENT.

	Well.	*Still under Treatment.*	*Ill.*	*Dead.*
Total material (number)	107	8	11	65
,, ,, (per cent.)	56	4	6	34
Sex:				
Men (number)	34	1	3	23
,, (per cent.)	55	2	5	38
Women (number)	73	7	8	42
,, (per cent.)	57	5	6	32
Age:				
Under 25 (number)	67	5	7	34
,, ,, (per cent.)	60	4	6	30
Over 25 (number)	40	3	4	31
,, ,, (per cent.)	52	4	5	39
Disposition:				
+ (number)	39	0	3	19
+ (per cent.)	64	0	5	31
– (number)	68	8	8	46
– (per cent.)	52	6	6	36
Duration of illness prior to institution of treatment:				
Under 3 months (number)	41	2	1	19
,, ,, (per cent.)	65	3	2	30
3-6 months (number)	32	3	6	24
,, ,, (per cent.)	49	5	9	37
Over 6 months (number)	34	3	4	22
,, ,, (per cent.)	54	5	6	35
Localisation:				
Right lung (number)	54	5	3	38
,, ,, (per cent.)	54	5	3	38
Left lung (number)	53	3	8	27
,, ,, (per cent.)	58	3	9	30
Unilateral (number)	86	5	2	43
,, (per cent.)	63	4	1	32
Bilateral (number)	21	3	9	22
,, (per cent.)	38	6	16	40
Cavity:				
+ (number)	49	3	6	36
+ (per cent.)	52	3	7	38
? (number)	43	4	4	21
? (per cent.)	59	6	6	29
– (number)	15	1	1	8
– (per cent.)	60	4	4	32
Temperature:				
Afebrile (number)	46	5	5	20
,, (per cent.)	61	7	7	26
Subfebrile (number)	49	3	6	23
,, (per cent.)	61	4	7	28
Febrile (number)	11	0	0	22
,, (per cent.)	33	0	0	67
Sedimentation rate:				
Under 30 mm. (number)	48	6	2	11
,, ,, (per cent.)	72	9	3	16
Over 30 mm. (number)	53	2	9	46
,, ,, (per cent.)	48	2	8	42

undergone fibrous healing. In the remaining nineteen cases in this group the disease in the untreated lung was more extensive, but even here such changes were limited to less than one-third of the lung, with one exception. Nevertheless, the results proved to be distinctly inferior in patients with bilateral lesions than in those with unilateral lesions. In this work we have not taken into consideration the significance of the localisation of the cavity, whether apical or basal, because in our material the number of basal cavities was too small to allow of any conclusions.

As to the *anatomical character* of the process, we have paid regard only to the question of the presence of a cavity, without taking into account whether the X-ray picture was interpreted as signifying an exudative process or a productive process. For we think that when a process appears roentgenographically as "exudative" while the sedimentation rate is low, and the temperature normal, the X-ray diagnosis is doubtful or wrong.

We have divided the cases into three groups: definite cavity, doubtful cavity, and no roentgenographically demonstrable cavity. There can be no doubt that cavities actually are present in many of the cases entered under the last two headings. On the other hand, there can be no doubt that nearly all the large cavities have been recorded under the first heading, and several cavities measured 3 to 5 cm. in diameter. Ninety-four patients unquestionably had a cavity, in seventy-two the cavity was doubtful, and twenty-five had no cavity. The difference of the results between the first group and the last is slight.

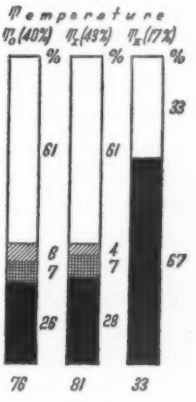

FIG. 3.
For explanation see the legend of Fig. 1.

The size of the cavities was without influence on the results, contrary to what Cold found to be the case under conservative treatment. Fifty-three patients had cavities measuring 1 to 2·5 cm.; of these patients twenty have died, five are ill, three are still under treatment, and twenty-five are well. Of forty-one patients with cavities from 3 to 6 cm. in diameter, seventeen are dead, two are ill, and twenty-two have recovered.

Then the material is subdivided according to the *level of the temperature* into three groups (Fig. 3): normal temperature (T_o), subfebrile (T_I), and febrile (T_{II}). As was to be expected, the febrile group (*i.e.*, patients with a temperature over 38°, in spite of confinement to bed) falls far below the two other groups in therapeutic results. But this group shows another interesting feature, too, in that it includes no representative of the intermediate classes, "still under

treatment" and "ill." The patients, originally febrile, have all died or recovered—something that is quite in keeping with the findings of other authors.

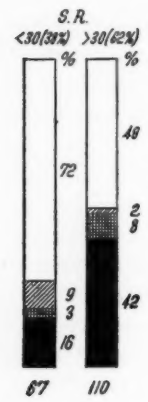

FIG. 4.

For explanation see the legend of Fig. 1.

Finally, Fig 4 illustrates the material analysed according to the level of the sedimentation rate at the beginning of treatment. Those patients who had a sedimentation rate under thirty at this time show considerably better lasting results than do the others.

PART II.

This section deals with the results in relation to the *anatomical character of the pneumothorax*. We have divided the cases into four groups (see Fig. 5):

Group I.: Pneumothorax roentgenographically free from adhesions.

Group II.: No costal adhesions, but the lung is adherent to the mediastinum, spinal column and medial part of the cupula.

Group III.: Circumscribed costal adhesions.

Group IV.: Incomplete pneumothorax with solid fusion of the upper part of the lung and the chest wall.

In Fig. 5 these four types of pneumothorax are presented schematically, and below each type the results are presented graphically, the left column in each pair of columns giving the result at the time of discharge, while the right column gives the lasting results. In the first two groups the cases are divided into cases spontaneously belonging to the respective group—left pair of columns—and cases that originally belong to Group III. but are transferred to Groups I. or II. after severing of the adhesions.

At their discharge, none of the patients belonging to Group I. and only two belonging to Group II. had a persisting cavity. These figures are so small that in the graphical presentation we have made no distinction between cavernous and non-cavernous. On the other hand, the cases in Groups III. and IV. are divided into cavernous and non-cavernous, according to the condition at the time of discharge. (Under the heading " cavernous " in Group III. several patients are entered who were abacillary at their discharge, simply because the sputum was examined frequently, even down to the day of discharge, while in several cases the last X-ray picture of the patient had been taken a few months before his discharge.)

A mere glance at Fig. 5 is enough to show that the lasting results correspond to the pneumothorax; the poorer the pneumothorax, the more

unfavourable are the permanent results. On the whole it may be said that when the pneumothorax was ideal, 80 to 90 per cent. of the patients became well; when, on the other hand, the pneumothorax was incomplete and the cavity persisted during the first stay in hospital, 80 to 90 per cent. of the patients died.

Another finding, not evident from Fig. 5, was that of the 62 patients in Groups I. and II. who were discharged abacillary, 7 died of tuberculosis

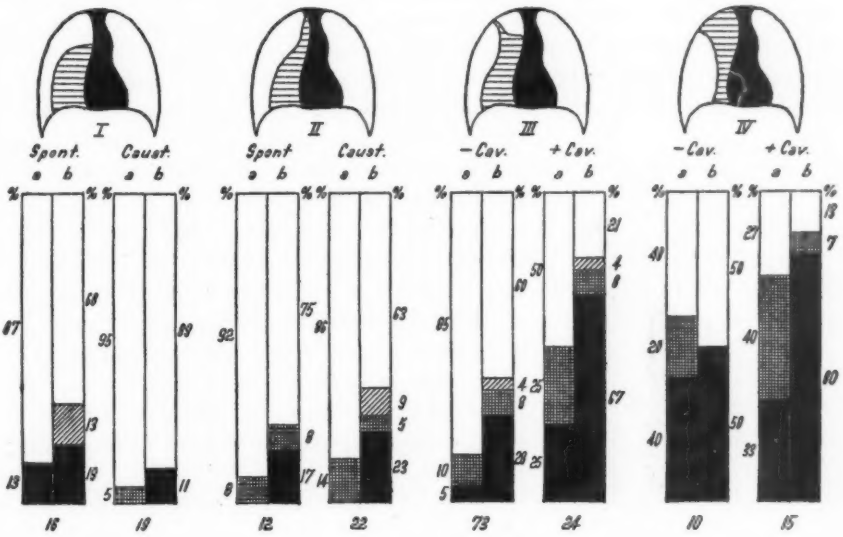

FIG. 5.

In each pair of columns the left column gives the result at the time of discharge from the hospital, while the right gives the "lasting result" (*i.e.*, result at this writing). Types I. and II. are divided into "spontaneous" cases (*i.e.*, cases naturally belonging to these groups, without severance of adhesions) and cases that can be reckoned as these types only after cauterisation of adhesions. In Types III. and IV. the patients are divided into non-cavernous at the time of discharge and roentgenographically cavernous. For other explanation see the legend of Fig. 1.

later on; of the 74 patients in Group III. that were discharged abacillary, 17 died. If, besides absence of bacilli in the sputum at the time of discharge, we insist upon roentgenographic disappearance of the cavity, this requirement is met in Groups I. and II. by 60 patients, 6 of whom died of tuberculosis. In Group III. this requirement was met by 62 patients, 11 of whom died later on.

Thus, of 62 patients who were discharged abacillary and without any roentgenographical cavity, but with adhesions to the chest wall, 11 died,

and 4 are still suffering with tuberculosis. These figures strongly urge upon us the advisability of active treatment of the adhesions even in cases where the immediate therapeutic result appears to be satisfactory.

As is evident from a comparison between Groups I. and II. (headings "spont." and "caust."), the results are just as good in those cases which are transferred by cauterisation from Group III. to Groups I. and II., as in cases that belong here without cauterisation ("spont.").

It is to be pointed out that the cauterised adhesions roentgenographically were comparable with the non-cauterised. So the poorer results in Group III. as compared with the cauterised cases in Groups I. and II. cannot be explained by the circumstance that the non-cauterised cases involved relatively short and wide adhesions—a type of pneumothorax approaching Group IV. The extent of the disease was practically the same in the cauterised and in the non-cauterised patients.

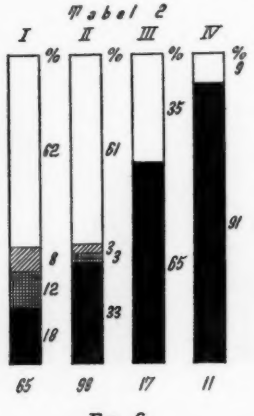

FIG. 6.

I., No exudate; II., serous or non-examined exudate; III., tuberculous empyema; IV., empyema with mixed infection. For other explanation see the legend of Fig. 1.

Besides the anatomical character of the pneumothorax, its *duration* is an important point, too. The present material gives no information of interest in this respect, however, as it has been the rule (with very few exceptions) to keep up the pneumothorax for at least three years unless this was prevented by synechiæ, exudate or the general condition of the patient.

As to the significance of *exudates*, the available data are not adequate for complete analysis. As fluoroscopy and roentgenography have not been employed so very often, the number of cases complicated by exudate is to be considered a pronounced minimum figure. The same applies to the incidence of empyema, as explorative puncture and evacuation have been employed only to a moderate extent (Fig. 6). A partial analysis (Table II.) shows that there is only a slight difference between the cases free from exudate and the cases complicated with benign exudate, the number of "well" under the two headings being almost the same. In the exudate-free group we find relatively more "ill" and fewer "dead" than in the exudate group. It will be noticed that the prognosis is poor in the empyema groups, also when the empyema is purely tuberculous (Table II.; *cf.* Fig. 6).

TABLE II.—SURVEY OF THE RESULTS IN RELATION TO COMPLICATION BY EXUDATE AND EMPYEMA (*cf.* FIG. 6).

	No Exudate (*Total, per Cent.*).	*+ Exudate, Serous or Non-aspirated* (*Total, per Cent.*).	*Empyema, Purely Tuberculous* (*Total, per Cent.*).	*Empyema, Mixed Infection* (*Total, per Cent.*).
Well	40–62	60–61	6–35	1–9
Being treated yet	5–8	3–3	0–0	0–0
Ill	8–12	3–3	0–0	0–0
Dead	12–18	32–33	11–65	10–91

PART III.

Fig. 3 (in Part I.) shows that the prognosis is more serious in febrile cases than in those who remain subfebrile and afebrile. Fig. 5 (in Part II.) shows that the prognosis is far worse with an incomplete pneumothorax than with a pneumothorax free from adhesions. Analysis of this kind, however, fails to reveal whether the decisive factor in this respect is the condition of the patient at the beginning of treatment or whether it is the character of the pneumothorax obtained, or whether perhaps both factors may be equally important. It is quite conceivable that the poor final results in the febrile cases are due to the circumstance that these cases are associated particularly often with changes in the pleura that lead to an unsatisfactory pneumothorax. This, in fact, has proved to be the case. Of the 33 febrile patients, 16 (48 per cent.) had a poor pneumothorax (see below). Of the 157 subfebrile or afebrile patients, only 33 (21 per cent.) had a poor pneumothorax. This again means that the group "poor pneumothorax" in Fig. 5 from the onset represents the worse cases, and that this perhaps is the main cause of the poor final results in Groups III. and IV.

In order to avoid dealing with small groups in this analysis the pneumothorax results will now be considered under two headings only, instead of the four types mentioned above (*cf.* Fig. 5)—namely, "good" and "poor." Here "*good*" comprises the cases classified above as Types I. and II., as well as those patients of Type III. who were free from signs of cavity at their discharge from the hospital; "*poor*" comprises patients of Type III. discharged with signs of cavity and all the patients of Type IV.

Table III (page 14) gives a survey of the results in relation to the "good" or "poor" pneumothorax obtained, with reference to the original conditions mentioned in Part I.

As to *sex* and *age*, the figures allow of no particular conclusion.

TABLE III.—CORRELATION OF THE RESULTS WITH REGARD TO ORIGINAL FACTORS AND TO THE CHARACTER OF PNEUMOTHORAX.

	Good Pneumothorax.		*Poor Pneumothorax.*	
	No.	*Per Cent.*	*No.*	*Per Cent.*
1. Men	39	64	22	36
Women	103	79	27	21
2. Age under 25 years	87	78	25	22
Age over 25 years	55	70	24	30
3. Disposition:				
+	46	75	15	25
−	96	74	34	26
4. Duration of illness prior to institution of treatment:				
Under 3 months	45	71	18	29
3-6 months	48	74	17	26
Over 6 months	49	78	14	22
5. Localisation:				
Right lung	70	70	30	30
Left lung	72	79	19	21
6. Unilateral	102	75	34	25
Bilateral	40	73	15	27
7. Cavity:				
+	61	65	33	35
?	60	83	12	17
−	21	84	4	16
8. Temperature:				
Afebrile	66	87	10	13
Subfebrile	58	72	23	28
Febrile	17	52	16	48
9. Sedimentation rate:				
Under 30 mm.	57	85	10	15
Over 30 mm.	73	76	37	24

When it comes to the presence or absence of *disposition* to tuberculosis, the distribution of "good" and "poor" pneumothorax is exactly the same in the two groups—a fact supporting the view that the prognosis is just as good in the "disposed" as in the "non-disposed."

The *duration of illness* prior to the institution of treatment showed only a moderate difference between the groups. The distribution of "good" and "poor" results is fairly uniform. The present data allow of no conclusion in favour of or against the early application of pneumothorax. Perhaps it will not be superfluous here to make the remark that even if

the results had been far better in the patients treated with early pneumothorax than in the others, this difference would by no means have proved the advantage of early pneumothorax, as long as we do not know how many patients recover spontaneously among those who are not given early pneumothorax.

" Good " pneumothorax was just as frequent in cases of *bilateral* affection as in *unilateral*; consequently, the fact that the final results are considerably poorer in the bilateral cases is to be ascribed to the lesion in the other lung.

It was surprising that the results were fairly alike in *cavernous* and *non-cavernous* cases—the more so because the cavernous group included several cases with poor pneumothorax.

Among the *subfebrile* and *afebrile* patients the pneumothorax was poor in 21 per cent. Among the *febrile* cases, on the other hand, it was poor in 48 per cent. But this difference alone does not explain the poor results in the febrile group, as is evident from the fact that, of 17 febrile patients with a good pneumothorax, 9 died—*i.e.*, 53 per cent.; while of the 66 afebrile patients with a good pneumothorax, only 14 died—*i.e.*, 21 per cent. So, even when the pneumothorax is good, the prognosis is poor in febrile cases.

The *sedimentation test* showed somewhat similar, though less pronounced, features as did the temperature.

Discussion.

The immediate results of pneumothorax treatment are so striking that documentation is unnecessary. The lasting results are far inferior to the immediate results, and often they are estimated much too favourably, partly because the observation period often is not long enough to bring out the sad difference between the results at the time when the patient is discharged from the hospital and the final result (Fig. 5), partly because in most reports far too small an allowance is made for the frequency of spontaneous recovery.

The *indications* for this treatment are still very uncertain and cannot be elucidated by the present material.

As to the *practice* of this therapy, the present account suggests that incomplete pneumothorax (Type IV., Fig. 5) ought to be given up soon and eventually be replaced by other active treatment. Further, also, *empyema* ought to be treated radically, as the prognosis in conservative treatment of this lesion is very serious even when the process is purely tuberculous (Fig. 6).

Even in cases where disappearance of cavity and bacilli was obtained by pneumothorax, but with remaining solitary *adhesions* to the chest wall (Fig. 5, Type III., non-cavernous), 11 out of the 62 patients in this group

died subsequently of tuberculosis, and 4 are bacillary, with poor prognosis. The results are twice as good in cases free from adhesions, spontaneously or after cauterisation. Therefore, we advise the performance of thoracoscopy and, if possible, cauterisation (in most cases about two months after the application of pneumothorax) whenever there are any adhesions to the chest wall, regardless of absence or persistence of cavity and bacilli.

In brief, the indications for pneumothorax therapy are still uncertain; on the other hand, to us there seems to be no doubt whatever that, once this treatment is commenced, it ought to be carried through more actively than has been done in the present material. Pneumothorax treatment should be carried through completely, or be given up and replaced by other treatment.

Summary.

An account is given of the late results of treatment by artificial pneumothorax in 191 patients within the period 1925-1931.

The results suggest that once pneumothorax treatment is instituted it ought to be carried out more actively than has been done here—and in most other clinics. Incomplete pneumothorax ought to be given up soon and replaced by other treatment, chiefly operative. In empyema, even when purely tuberculous, the prognosis with conservative treatment is poor; hence, early radical treatment of this lesion is indicated. Solitary adhesions to the chest wall ought to be severed by cauterisation, even though the cavity and bacilli have disappeared.

SOME OBSERVATIONS ON ALPINE CLIMATE

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During the past few years I have on several occasions written concerning the " rationale " of treatment by Alpine climate, and the advantages and characteristics of such a climate. This present paper is really an analysis, with certain alterations and additions, of previous papers of mine, but I thought that some collected notes on the climate of an altitude of 5,000 to 6,000 feet might once more be presented with advantage in this journal.

I wish to thank Professor Dorno and Professor Mörikofer of the Davos Meteorological Observatory for their kind help.

During the course of thirty years' experience of pulmonary tuberculosis, and having had the disease myself, I have come to the conclusion that the only real cure lies with the resistance of the patient. In other words, a patient must be placed in those circumstances which will improve his physical state, put up his resisting powers, and enable him to control his disease with success.

We all know of the innumerable so-called " specifics " and T.B. " cures " which have appeared incessantly, only to sink into oblivion, and be supplanted by something newer—medicines, drugs, herbs, injections too numerous to mention, inhalations *ad infinitum*; and finally operations—artificial pneumothorax and its supplementary proceedings, such as division of adhesions, and oleothorax, phrenic-nerve avulsion, thoracoplasty, partial or complete. These proceedings are certainly a great advance in the treatment of pulmonary tuberculosis and of the greatest value in selected cases, but they are not " cures " in themselves. They only aim at placing the patient in a favourable state for the natural cure to be effected, which consists in the isolation and cicatrisation of the tuberculous lesions by the production of fibrous tissue. These proceedings are termed " direct attack," but it is the subsequent " indirect attack " which is the most important factor, and by this I mean placing the patient in circumstances and surroundings by which he is better enabled to fight the disease, owing to the improvement thereby obtained of his resistive powers and general health.

Natural cure is always the best in the long run, if it can be obtained. This being the case, climate must necessarily exert a powerful influence, and it is with this idea that I have written these observations on the climate of altitudes. Three essentials are really necessary for a good result:

1. A sensible doctor in co-operation with a sensible patient, early diagnosis and prompt action.
2. A long period of time.
3. Freedom from financial or other worries.

It is common knowledge that a holiday in the mountains for the healthy worker provides him with a remarkable renewal of mental and physical powers, enabling him to return to his duties with quickened forces and helping him in the resistance of disease. And since such undoubted benefits are seen to be derived from a short holiday by the normal healthy individual, it is natural that medical men should not be slow in seeking for the delicate, sick, and convalescent the healing and invigorating influences associated with residence in Alpine resorts.

In considering the selection of cases and arranging for the particular health station best suited to each individual, it is necessary that advice

should be based upon actual knowledge of the physical and mental characteristics of the patient, as well as the nature and extent of the disease. The medical man in attendance should also be acquainted with the conditions obtaining in the particular region chosen. In too many cases advice is given and decisions arrived at in a haphazard kind of way, with a very perfunctory study and a superficial understanding only of these all-important data. Patients are often urged to go to Switzerland without any idea of the kind of place to which they are going, and, indeed, in many cases the person who gives the advice is unable to provide this very requisite information.

In this article I propose to consider the climate at a height of 5,000 to 6,000 feet above sea-level, since it is at this height that the greatest and most permanent results are obtained, and I am taking Davos as the example of such a climate.*

The advantages of a sheltered, elevated valley climate are admitted. These are lower atmospheric pressure; protection from wind; freedom from fog; cool, dry air, free from dust and microbes; a high degree of isolation, both qualitatively and quantitatively; and a high degree of radiation.

As is well known, the high mountain climate differs fundamentally from all other climates by reason of its lower atmospheric pressure. With respect to its physiological effect, besides the stimulation to increased breathing and blood formation, due to the less weight of oxygen in each volume of air breathed in, the mechanical results of the lowered pressure must not be overlooked. In the middle of the summer the average atmospheric pressure on Alpine heights of 1,500 to 1,800 metres elevation is about 8 to 10 mm. higher than in winter. In comparison with the winter climate, the summer climate is that of a place about 150 metres lower. The shelter from wind, which the high mountain ranges to the west and east afford to the valley of Davos, generally keeps out extremely bad weather

* Many works have been written on the climatic treatment of disease, and in most of these reference is made to tuberculosis. A valuable chapter on tuberculosis will be found in *A Handbook of Climatic Treatment including Balneology*, by the late Dr. William R. Huggard, for many years British Consul at Davos. The work was issued in 1906 by Messrs. Macmillan and Co., Ltd.

The most complete and up-to-date description of the nature, action, and practical application of physical facts usually classified under the headings of meteorology and climatology, and dealing with aerotherapy, heliotherapy, and other influences active in the so-called open-air treatment of tuberculosis, will be found in the two volumes prepared by Dr. Leonard Hill, acting under the Medical Research Council of the Privy Council: *The Science of Ventilation and Open Air Treatment*, by Leonard Hill, M.B., F.R.S., Director of Department of Applied Physiology, Medical Research Committee, Part I., 1919, pp. 249; Part II., 1920, pp. 295. Published for the Medical Research Council of the Privy Council by His Majesty's Stationery Office, Imperial House, Kingsway, London, W.C. 2.

in summer as well as in winter, seldom admits violent storms to the valley, and at the same time regulates the circulation of the air, so that on all sunny days there is a cooling valley wind from early in the morning till towards the evening. The velocity of the wind is in January 0·60 metre per second; in July, 1·65 metres per second.

The variation of cloudiness in the course of the year in the heights of the Swiss mountains is, roughly speaking, opposite from that in the South and Midland districts of England, the maximum falling in summer, the minimum in winter. Nevertheless, the cloudiness in Davos in summer does not exceed the mean cloudiness of the South of England, is more favourable than in the Midlands, and much more favourable than in the North of England and Scotland. In summer there is scarcely any fog; out of 300 July days there occurred only one day with a few hours' continuous fog. In summer the dryness of the air is not so extreme as in winter; in fact, the relative humidity exhibits an absolutely lower degree, a daily mean of 75 per cent. in July against 81 per cent. in January (at midday 58 per cent. in July as against 70 per cent. in January); while, on the contrary, the absolute humidity in July rises to three times that of January—namely, 7·86 against 2·39; and with this, the physiological deficit of saturation (the difference in the water vapour contained in 1 cubic metre of the air with that which 1 cubic metre of air contains when saturated at 33° C.), which influences the evaporation from the lungs and skin, sinks from January to July from 44·3 to 38·8. The greatest difference between summer and winter is in the temperature of the air; the January mean of 7·1° C. is opposed to one of 11·8° C. in July. In the extreme months it amounts to:

	January.	*July.*
Mean of maxima	− 1·1	+17·7
Mean of minima	−11·9	+ 5·9
Mean of absolute maxima	− 5·1	+24·6
Mean of absolute minima	−21·9	+ 0·7

The average maximum of July lies about 4·1° C. lower than on the south coast of England; the absolute maximum about 6·4° C. lower than in London, where a maximum of 31° C. has been recorded. These figures are proofs of the coolness persisting during the height of summer in the high mountains, witness the low average minimum of July of 5·9° C. The regular cooling effect which occurs each evening is of greatest advantage to lung cases and convalescents when, as in the high mountains, it is combined with dry air.

In summer the freedom of the air from dust is guaranteed by the high valley being covered with an almost uninterrupted extent of meadows

surrounded by woods; its freedom from sources of infection by the dry, cool air which descends every evening from the high mountains. In conjunction with the ionising effects of the sun's rays, which are rich in ultra-violet rays, this descent of the air conduces to the electric conductivity, which in summer becomes about double that in winter.

The intensity of solar radiation, so marked a feature of the high mountain climate, is strongest in the summer months. As a matter of fact, however, the whole energy of the direct solar radiation does not reach its maximum in the high summer months, because the more humid atmosphere of the summer weakens considerably the ultra-red part of the spectrum; nevertheless, the high sun in the summer is the richest in the most important rays of the sun from the biological point of view, the ultra-violet. In July the sun is hardly hotter than in January, but about ten times as rich in ultra-violet rays. It is a great advantage that, during the warm air temperature of the summer, relatively few of the penetrating ultra-violet rays are present; on the other hand, they are plentiful in the cold seasons of the year (winter and spring), when they are desirable. While there are thirteen days of January with 75 to 100 per cent. of the possible hours of sunshine, there are only 10·4 such days in July; but as in July the sun is about twice as long in the sky as in January, there is ample opportunity afforded for the use of its rays in summer, and so in prescribing the amount of the dose it is necessary to warn against " too much."

The normal working of the body is contingent on certain meteorological conditions, the medium for which is the air. The air holds gases, dust, and moisture; it acts as a vehicle of heat, a modifier of light, and a conductor of electricity. The effects of these varying phases of matter and energy on the human organism are of great interest, and, though much yet remains to be discovered, a brief summary of those at present within our knowledge may be attempted in so far as they concern mountain climate. The changes that result from residence at high altitude have a number of special features, and in preparing these notes much valuable information has been derived from the writings of the late Dr. W. R. Huggard and Dr. Leonard Hill, already referred to in this article.

When climatic influences are modified by an increase of altitude the organism undergoes physiological modifications to meet the new conditions. Subjectively, there is a feeling of stimulation, and the basis of this is probably a series of changes of a functional kind, only some of which are understood.

In the mountains the barometric pressure is low in proportion to the height above sea-level, and the partial pressure of oxygen is correspondingly diminished; the physiological result is that breathing is deeper, for the pulmonary ventilation has to be increased if the tissues are to receive their

proper oxygenation. The tenuity of the atmosphere, combined, indeed, with other influences—such as brighter light—leads also to an enrichment of the blood, so that there is a greater amount of hæmoglobin in circulation, and a larger number of red corpuscles to carry it. At a height of 5,000 feet, for example, the increase may amount to from 20 to 30 per cent. The increase of hæmoglobin and red corpuscles is not merely an apparent one due to a diminution of plasma, but is a real augmentation, and, indeed, it appears from animal observations that the total amount of blood itself is even increased. It has also been observed that an increase of lymphocytes occurs—a finding of especial interest with reference to tuberculosis. The air at higher altitudes is richer in oxides of nitrogen (often wrongly called ozone), which possibly have some beneficial action on the respiratory tract.

Mountain air is almost free from dust, more particularly when the snow is on the ground, and is therefore less irritant to the respiratory passages. The presence of silica in dusty air has been shown to be particularly deleterious, and acts, as it were, as an activator of tuberculosis. Dust also includes bacteria, and from these mountain air is almost entirely free.

There is very much less moisture in the air of mountains than at lower levels, and this dry air has a stimulating effect on the respiratory membranes. Hill considers that the beneficial action is due to the fact that, since the air breathed out must be saturated with water vapour at the body temperature, the mucous membrane is subjected to a greater flow of blood and lymph, which factor has a cleansing action discouraging to infections. And, again, because of the low humidity, while it is warm in the sunshine, it is cold in the shade (there may be a difference of 50° C.), and Hill has further shown the powerful effect of this in stimulating metabolism. The greater cooling of the body by reason of the cold air and the evaporative power due to its dryness necessitates a greater production of body heat, and so an increase of metabolism. One lives more intensely and at a greater speed. The cooling power of Alpine air, as measured by Hill with the katathermometer, is three times greater than in ordinary conditions indoors, and the evaporative power twice as great; the result is that heat production may be raised from 40 to 90 per cent., according to the degree of exposure; wind leads to still further increase of heat production. The heightened metabolism thus induced leads to a general tonic effect; the appetite is stimulated, and there is a more ample circulation of nourishment to meet the extra demand.

It is well known that the absence of light has a deleterious effect on the human organism. The successful practice of heliotherapy has abundantly demonstrated the beneficial power of the sun's rays, although the more precise nature of their action remains largely to be explained. From a number of causes, the heating and lighting powers of the sun are greatly

increased at the higher levels. They are rendered more available because they are much less obstructed than at low levels. Roget states that at sea-level 32 per cent. of the heating effect of the sun is lost, whereas at a height of 3,000 metres only 11 per cent. is lost. The low humidity and the comparative absence of dust leave the air purer, and therefore more highly diathermanous. Then, again, there is a longer duration of sunshine, especially on the southern slopes of valleys, and especially in winter, owing to the relative rarity of clouds. In winter, too, the sun's power is greatly enhanced by the reflection of the radiant energy from the snow-fields. In the higher Alps, then, there is sunshine of a more extended duration and greater intensity than at lesser altitudes.

Exposure to sunshine has both local and general effects, the most obvious of which are sunburn and pigmentation. The local response of the skin —*i.e.*, sunburn, or erythema solare—is an inflammatory reaction which may be beneficial in some local morbid conditions, but which must in any case be carefully controlled, since a deep burn may follow an excessive exposure. Like sunburn, tanning is evidence of a heightened metabolism of the skin, and its occurrence is of great practical moment, although its exact significance remains obscure. People vary greatly in their susceptibility to tanning, some entirely failing to tan. It may be said that in general this pigmentation of the skin is associated with a resistance to disease. The local disease-resisting effect may be exemplified by the facts that acne and small-pox pustules avoid tanned skin. But this tanning has relations to remote as well as to local conditions, for it has been found that tanning of the skin is associated with amelioration of morbid conditions in internal organs, and in those who do not tan these remote benefits of exposure to the sun are lacking. Considering, on the other hand, that exposure of the untanned skin to the sun may be followed by an exacerbation of such remote signs (*e.g.*, a focal reaction in pulmonary tuberculosis comparable to what may follow a dose of tuberculin), it is believed that the pigment of tanned skin is of a protective nature, saving the deeper tissues from the action of rays having an unfavourable effect. The tanned skin is no longer liable to sunburn. These considerations indicate that heliotherapy is a double-edged weapon, to be used only with a knowledge of its capabilities. The biophysics of the matter are obscure; the penetrative power of the sun's rays varies with their wave-lengths, only the red-yellow rays having any great power of traversing the skin, although Malgat states that some of the rays may even pass through the depth of the body and affect a photographic plate on the other side—a statement doubted by Rollier. Now, it is known that certain fluorescent substances—*e.g.*, eosin—are able to transform short-wave (sunburning) rays into long-wave

(heat) rays, and Rollier and Rosselet have suggested that the pigment of tanned skin exerts a similar function, protecting in this fashion the deeper tissues from the detrimental effects of short-wave rays. These latter, therefore, provoke the formation of a barrier to prevent sunburn and the concomitant general disturbances.

Sunlight has a direct bactericidal action, which is utilised in the treatment of superficial infective conditions, and also for stimulating the healing of wounds and ulcers. It has also an analgesic property of therapeutic importance, and the great warming power of the Alpine sun while yet the air is cool and evaporative may be again referred to in its relation to metabolic stimulation. In this connection, too, it may be recalled that exposure to sun and air has a tonic effect on muscle, so that an immobilised limb does not atrophy as it would when bereft of these influences. This is doubtless to be correlated with the fact that muscle plays a large part in heat production, and the importance of exercise for the same reason is obvious.

There are some indications that electrical disturbances and radio-active phenomena may have some action on the organism, but as yet no definite statement can be made.

The universally recognised psychological effect of sunshine is elsewhere remarked upon in this paper.

Acclimatisation to altitude consists in adaptation to the changed meteorological conditions. Increased pulmonary ventilation, the enrichment of the blood, the strengthened action of the heart, and the response of the skin, alimentary tract and kidneys to the altered metabolic demands, establish the vital mechanism at a new level. Visitors to a height of 5,000 to 6,000 feet seldom suffer much inconvenience, but slight degrees of headache, sleeplessness, lassitude, flatulence, and breathlessness are to be met with sometimes. Acute symptoms are probably due to the liberation of gases in minute quantities in the tissues, owing to the lowering of barometric pressure, and they are proportional to the rapidity of ascent. Since the new gas pressure relations are quickly established, these symptoms are transient, and need no great consideration at such an altitude as that being discussed. Such discomforts do not usually last longer than ten to fourteen days, if they occur at all. The young, who bear cold better, acclimatise more rapidly and thoroughly than the old.

It is quite an error to think that the climate of the high mountains is advantageous to patients in the winter time only. Clinical observation has made it clear to us that the summer is at any rate equally as good, and in the opinion of many of the medical men in Davos with wide experience of tuberculosis patients actually receive more benefit and get

quicker recoveries in the summer months than they do in the winter. During the summer in the Alpine health resorts the ultra-violet rays are far stronger than in winter, and the sunshine there is much richer in such rays. The patient can be exposed to this, and to cool air in full daytime, or to the weaker sun and cool air of the early morning, thus reaping the benefit without running any risk of overdosage from these health-giving rays.

In the winter the rarefaction of the air, the coldness and the dryness of the air, are greater than in the summer, but in the summer there is more breeze, movement, and radiation than in the winter. Freedom from microbes and dust is maintained throughout all the seasons. The most important climatic factor, the demand for warmth (the amount of cooling power), is in summer less than in winter, and this agrees with the facts known clinically, that weak and feeble individuals are more easily acclimatised in summer than in winter, and therefore are likely to derive better results in the summer months than in the winter months.

While a great deal remains to be explained and discovered, the important deduction may be reached, after such a rapid survey of the subject, that a patient must have the ability to carry out the physiological modifications demanded before he is enabled to combat his disease with the strengthened weapons that Alpine residence provides.

Following upon the previous remarks concerning general conditions, and especially the physical and physiological factors obtaining in the mountains at a height of 5,000 to 6,000 feet, we may now consider the question of residence in the Alpine climate from the therapeutic point of view, especially having regard to that commonest of all diseases, and that for which people are most often sent to the mountains—namely, tuberculosis. Tuberculosis in all its forms, whether pulmonary or surgical (that is, tuberculosis of bones, glands, joints, or serous membranes), is, without doubt, considerably influenced by climatic conditions. In fact, in many cases climate is such an important element in the treatment of this disease that it is not too much to say that it may easily be the deciding factor as to what course the disease will take—in other words, whether the patient will get well, become a hopeless invalid, or die. It is a pity that the all-important question of seeking a really suitable climate for patients affected with this disease, especially (and this is a most important point) in the early cases, is so often overlooked and neglected. The malady has frequently already obtained such a hold upon its victim as to make ultimate cure impossible.

Direct attack upon the various forms of tuberculous disease is, in our present state of knowledge, often very difficult, or even impossible. Indirect attack, then, remains the most general method which we have at

present for coping with tuberculosis. By indirect attack is meant a modification of tissue change and improvement of the general health and nutrition, thus raising the reactive and resistive power of the patient, and enabling him better to fight his disease. The best way in which this result can satisfactorily be obtained is by the judicious and considered use of " climate."

In dealing with any particular case of tuberculosis of the lungs there are two essential points which demand the consideration of the physician. One is the present general health and condition of the patient, and the other his probable power of reaction and resistance to disease.

The first requirement is to consider in any case of tuberculosis the state of the patient as regards his general nutrition, and the aim and object must be to raise this to the highest possible level. A great point was sometimes made, especially in former days, of increase of weight, and it was thought that increase of weight must mean that the patient was progressing most favourably towards a cure. These efforts at fattening frequently resulted in flabbiness, diminished power of resistance, chronic dyspepsia, and ultimately did definite harm.

Referring back to the remarks of the physical and physiological conditions at an altitude of 5,000 to 6,000 feet, it would be seen that at this height conditions tend to improve the general health and resistive power of the patient; but it should be remarked that cases must be carefully chosen, and that it is the reasonably early cases with still plenty of kick and vigour in them who do best in the mountains. It is useless to send up to a height persons enfeebled, emaciated by long-standing tuberculous disease, and with no power left in them to respond to the more exacting demands which are made upon the organism. A patient suffering from tuberculosis, whilst the disease is in the very early, acute, and active stage, should, as a rule, not be sent away from home until the acute process has settled down. In this stage it is much better to keep him at absolute rest in bed until the most acute symptoms have subsided. There are many second and even third stage cases who do quite well in the mountains, although, of course, they must not expect a complete cure, but one knows of patients with old extensive fibrotic disease who, winter after winter, return for a sojourn in the Alps, having found out that by so doing they gain fresh power of resistance and energy, and are thus enabled to carry on their occupation and work during the rest of the year.

Old-standing cases of phthisis, especially in elderly men with much fibrous tissue formation and with thickened arteries and heightened blood pressure, should not be sent to an altitude. They are not comfortable, and often get an increase of catarrh, and as a general rule do badly. One

often hears the remark that hæmorrhage cases should never be sent to the mountains. This is true, perhaps, of that type of disease of which we have just been speaking—namely, the chronic fibrotic cases in elderly people, with increase of blood-pressure—but it certainly does not apply to the hæmoptysis occurring in young people in early, or not very advanced, stages of the disease. These frequently do very well in the mountains.

For cases of surgical tuberculosis a mountain climate is eminently suitable. The radiant energy of the mountain sun is much more active in the clear, thin, pure air of the mountains than at lower levels, where the rays are filtered through layers of heavy humid atmosphere holding in suspension dust, smoke, and micro-organisms.

In the first place, sun treatment is most intimately associated in one's mind with localised or surgical tuberculosis, and in this connection young patients and children do very much better than those of more advanced years. Dark-haired subjects, as a rule, do better than fair-haired ones, as they pigment more easily and deeply, and the cases who pigment the most seem generally to derive the most benefit. Red-haired people are the most difficult of all, and do not appear to be able to tolerate the sun well, so that one has to accustom them to exposure very carefully and gradually. Tuberculous glands, bones, and joints in young subjects do exceedingly well, the effect of the sun being apparently to cause the absorption and disappearance of adhesions, and the restoration of movement to joints which were previously stiff. Other conditions which derive much benefit from heliotherapy are chronic peritoneal tuberculosis and tuberculous abdominal glands.

Open tuberculous lesions, sinuses, and fistulæ in connection with joints and bones, close and heal in a remarkable manner under the sun's rays. Others, not tuberculous, such as unclosed empyemata, sinuses, ulcers, and other septic conditions, frequently derive much benefit from a course of sun-baths. Cases of lupus improve with the sun treatment, as do many other chronic skin diseases.

A word of warning, however, should here be given. Whilst the sun treatment scientifically carried out is so very beneficial in many cases of surgical tuberculosis, it should not be used as a general rule in pulmonary cases. There may be, it is true, a limited number of pulmonary cases in which a modified sun treatment might be tried, but, as a rule, it is definitely harmful for patients with tuberculosis of the lungs to sit about uncovered in the sun. Congestions, hæmorrhages, and activity are often produced in this way.

Another type of individual for whom a mountain climate is eminently beneficial and suitable is the sub-tuberculous type of case—in other words,

a predisposed individual in bad general health and in whom the presence of the disease is suspected, and especially if of bad family history. Backward children with adenoids, general debility, and a tendency to catch cold and catarrh do excessively well in a mountain climate.

Bronchial asthma reacts in the most remarkable manner to the Alpine climate. The effect is often almost miraculous, and if the patient will remain for a long enough period the benefits obtained are frequently permanent. Unfortunately there is a tendency for patients when they experience great improvement, which often happens, to return home too soon. Real attacks of asthma are rarely seen in the mountains. As a result of freedom from these distressing symptoms, patients are able to sleep better. They lose the feeling of apprehension and depression, the whole outlook on life becomes more optimistic, the general health recovers, the associated bronchitis and dyspnœa abate, the heart regains its strength, and the capacity for exertion is progressively increased.

In asthma the most striking results of all are observed in children. This may be easily understood, because in such cases secondary changes such as cardiac weakness, chronic bronchitis, and emphysema have not yet had time to develop, nor have actual structural alterations to the chest wall. In children especially, improvement is very rapid. The attacks quickly cease, and one can see from day to day gain in health, physique, and character. I can almost assert that in practically every case, if an asthmatic child is sent to live in the mountains (a height of about 5,000 feet seems to be the most efficacious), the affection can certainly be cured, but a stay of less than a year is not really of great permanent value, and two years are better. Education can easily be carried on, and the child does not lose time from having continually to be away from school on account of ill-health.

Tuberculous ulceration of the larynx, if unaccompanied by great irritability and congestion of the mucous membranes, as a rule does well in the mountains; but, of course, it is no use sending pulmonary cases in the third stage with extensive laryngeal involvement, for they are made more unhappy and uncomfortable in the dry climate of a high altitude, and derive no benefit.

Chronic bronchial catarrh and bronchiectasis, if occurring in young persons, often does extremely well in the dry climate of the mountains, but in old people, when it occurs as a complication of long-standing phthisis, or accompanied by emphysema, the results are not good; the patient is uncomfortable and breathless, and the catarrh, congestion, and irritability of the mucous membranes are increased. In these elderly people, too, the power to respond to a cold, dry climate is often lost, and too great a

strain is thrown upon the heart. This class of case would do better and be more comfortable in a warmer and less dry climate.

Mountain climates are also very suitable for cases of anæmia and debility, and convalescence after acute diseases, malaria, or operations.

Summary.

To resume: The Alpine climate (as exemplified at Davos 5,200 to 6,000 feet above the sea) differs from that of the plains in the following characteristics:

Cool, dry air. Absence of wind, especially in winter; *increased intensity of solar radiation* (the heat energy of this stimulates the circulation of blood through the body, but of even greater value is the specific action of the ultra-violet radiation, a powerful agent, both prophylactic and healing).

The pure and clean air. Absence of dust, particles of soot, dirt, micro-organisms, and other contaminations of necessity met with in the air of the plains, and especially of towns.

Diminished atmospheric pressure. This leads to diminution of the oxygen content, and thus encourages deeper breathing and rejuvenation of the red blood cells.

Cooling power. The cold, dry, calm air has a most important effect on its cooling power, and so on the sensation of warmth. The temperature of the air is low. It is never unpleasantly hot in the summer months, and in the winter, although the thermometer may be far below freezing point, this dry, still cold is neither unpleasant nor injurious. Research has proved that Davos, for its height, has a climate which makes remarkably small demands for heat production, and thus exerts a minimal strain on the heat-regulating mechanism of the body.

Davos may thus be taken as an outstanding example of a good mountain climate, eminently suitable both as a prophylactic and a healing agent in certain morbid states. This therapeutic power is certainly as good in the summer months as in the winter. In the opinion of some medical men of long experience the best results are obtained in the summer.

The principal conditions which may expect to derive benefit from a sojourn in the Alps are, briefly, the following:

Pulmonary tuberculosis, if not too far advanced; surgical tuberculosis; asthma, chronic bronchitis, and bronchiectasis; convalescence after acute illness; anæmia. Mountain climate is especially suitable for delicate, backward children, predisposed to tuberculosis and of bad family history—cases, for example, of poor physical development, enlarged glands, chronic bronchial trouble, asthma or adenoids. In this type of case there is always a very rapid and encouraging improvement.

TUBERCULOUS TRACHEO-BRONCHITIS

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Tuberculous lesions in the respiratory passages distal to the larynx may vary from the slightest degree of infiltration of the submucous layer to massive granulations which may completely block the lumen.

The condition is always associated with pulmonary phthisis, usually the more advanced type, with tubercle bacilli in the sputum, though it is true that in some cases the bacilli are the result of the tracheal lesion rather than the cause. Tuberculous lesions in this area are not easily recognised, partly because they cannot be inspected except through an endoscopic tube and partly because they do not give rise to any very characteristic symptoms.

It is unusual to be able to see any portion of the subglottic space in the laryngeal mirror, except the part of the anterior wall immediately below the anterior commissure. These two negative properties, lack of distinctive signs and difficulty in inspection without a somewhat elaborate technique, have resulted in the condition being overlooked in very many cases.

Various series of cases have, however, been investigated by post-mortem examination and by bronchoscopic exploration.

Habershon (1905) reported 1,255 necropsies at the Brompton Chest Hospital, and found that the larynx was involved in 47·4 per cent. and the trachea in 10·4 per cent. of cases. Eppinger (1880) and Gougenheim and Tissier (1889) had already described the condition at considerable length.

Heaf (1924) reported 133 necropsies in which 58 cases (44 per cent.) of disease of the trachea were found.

Minkowsky (1929) reported, as a result of 5,000 post-mortem examinations, that there were 19 per cent. of cases suffering from tuberculosis of the larynx, 8·5 per cent. of tuberculosis of the trachea and of the larynx, and only 3 per cent. in which the trachea was affected with a normal larynx. A total of 11·5 per cent. of cases, therefore, had tuberculosis of the trachea. Minkowsky quotes Heinze as recording 8·5 per cent., Willigk 5·6 per cent. and Dobromilsky 25 per cent.

Warren, Hammond, and Tuttle recorded 13 per cent. in unselected

cases, and 57 per cent. in cases selected for thoracoplastic operations, and therefore presumably of a severely infected type.

It appears from these and other figures that tuberculous lesions occur in about 10 per cent. of all cases of pulmonary phthisis, but that in the more severe types of the disease, such as those requiring thoracoplasty, the incidence is very much higher.

Caliceti, quoted by Bettin, examined the tracheas of fifteen patients with tuberculosis of the lungs and larynx. Of these five showed tuberculosis of the trachea, seven had catarrhal lesions and the remaining three were quite normal as regards the trachea. Bettin, himself, examined fourteen tracheas from patients with pulmonary phthisis in whom there was no macroscopic evidence of tuberculosis in the larynx. In five there were definite microscopic inflammatory changes which were not tuberculous, in six there was a very slight catarrhal change, and in three there was no lesion in the trachea.

These catarrhal changes consist of a small-celled infiltration of the submucous layer, with congested vessels, and they are said to be caused by the irritative effect of the sputum which adheres to the walls of the trachea.

Lewy describes (1937) five different types of tuberculous lesions of the trachea.

1. Lesions associated with tuberculous disease in the lungs and larynx.
2. Miliary hæmatogenous infection which is part of a generalised miliary tuberculosis.
3. Lesions due to a lymphatic spread from infected paratracheal lymph nodes.
4. Similar lesions to the above but in the presence of a quiescent focus in the lung.
5. Primary lesions in the trachea, which he states are very rare.

Minkowsky (1929) considers that some of the cases may be due to direct infection from the surface from bacilli-laden sputum, especially if the surface has been damaged by coughing and attempting to clear away adherent sputum. The trachea with its ciliated epithelium has very strong defensive powers, and he considers that direct implantation is not a very common method of infection. He considers that the very rich lymphatic supply of the trachea provides a channel of infection from the more distal parts of the respiratory system.

Reichle and Frost (1934) consider that the infection usually reaches the trachea by direct spread along the lymphatics, either from the lung or from infected lymph nodes. They agree with Minkowsky that the

bacilli are rarely able to penetrate the tracheal mucosa from the sputum, and also consider the defensive mechanism of the trachea adequate.

Bugher, Littig, and Culp (1937) are of opinion, however, that the infection is very often caused by direct penetration of the bacilli from the sputum. They record as evidence the facts that the sputum is always heavily laden with bacilli and that the lesions, when seen in their early stages, are always very closely associated with the epithelium and the mucous glands. These remarks apply to the bronchi equally with the trachea. These authors admit that in certain cases the infection may be from peribronchial structures, especially lymph nodes at the hilum of the lung and in the mediastinum. The trachea may also be involved by direct spread from the neighbouring lymph nodes.

Tuberculosis of the tracheo-bronchial tree is most common between the ages of 20 and 40, though it may occur in very young children. Moorhead (1937) reported a case of bronchial infection in a child of 17 months.

It is almost always associated with pulmonary disease, which is as a rule of considerable duration. It is not of necessity associated with very severe infection of the lungs, cases being reported (Barnwell, Littig, and Culp, 1937) where the lung disease was only slight and relatively inactive. In other cases it has developed in patients in whom the pulmonary lesion was under control. In the majority of cases, however, there is an advanced state of pulmonary tuberculous infection. In a large proportion of the cases the disease is associated with a lesion in the larynx, but this is not invariably the case.

Bugher, Littig and Culp (1937) showed that in 122 autopsies there were 22 cases of tuberculosis of the trachea and bronchi which showed no disease in the larynx, while in 28 cases it occurred in the larynx as well. In only 9 of these patients was there infection of the larynx with none in the trachea and bronchi. Samson found that of 18 cases of tracheo-bronchial disease, 10 had normal larynges.

Where the larynx is involved and there is tuberculous disease of the trachea, it will be found in the upper part of that tube with perhaps also some lesion in the lower part of the trachea and in the bronchi. In those cases in which the larynx is normal there is rarely any lesion in the upper part of the trachea, the disease being confined to the lower half of the tube and the bronchi. An exception to this is the massive tuberculoma which is most frequently found in the upper third of the tube, and there is often no other lesion except in the lungs.

St. Clair Thomson (1937) states that the anterior part of the trachea

wall is rarely affected but that the membranous posterior portion is the most usual site of the disease. He quotes Gougenheim and Tissier in saying that the disease is more likely to begin in the membranous portions between the cartilaginous rings than on the rings themselves.

The tuberculous lesions are described by J. D. Kernan (1937) and by Reichle and Frost (1934) as falling into three groups.

The first group consists of the ulcerative lesions which occur perhaps more frequently in the trachea than in the bronchial tree. The ulcers rarely attain very great size, but may be multiple, may be scattered throughout the extent of the trachea and may coalesce to form larger ulcerated areas. They may occur also in the main stem bronchi, but in the smaller bronchioles only very small ulcerations are seen and these uncommonly. The ulcers are active, may give rise to small hæmoptyses and to the presence of tubercle bacilli in the sputum. Small ulcerations may explain those cases where there is apparently a quiescent lesion in the lungs or a complete collapse of an involved lung or lobe with a persistence of bacilli in the sputum. The ulcers have a tendency to heal and to give rise to stenosis, on account of the amount of fibrosis which may be formed during healing.

The edge of the ulcer and its surroundings may become œdematous and cause such an amount of swelling as to obstruct a bronchus, even the upper lobe bronchus, and may in that way give rise to atelectasis. Such swelling, if it occurred in the more distal parts of the bronchial tree, would very easily cause obstruction of the secondary bronchi. It may reduce the lumen of the trachea sufficiently to cause wheezing and even dyspnœa on exertion, though rarely a serious obstruction.

The second group of cases consists of those where proliferation of tuberculous granulation tissue takes place and tumour masses of varying size may be formed. These masses may occur in the smaller bronchi and cause obstruction and collapse of a portion or of the whole lung. They often occur in the immediate neighbourhood of the mouth of a branch bronchus.

When these masses of tuberculous tissue occur in the trachea they have a tendency to form in the upper third or even the subglottic space, and in this region they are visible in the laryngeal mirror. In this position they become large enough to cause troublesome or even dangerous dyspnœa.

Gilroy Glass (1938) reported a case of a tuberculoma of the upper third of the trachea, which caused sufficient obstruction to necessitate a tracheotomy.

Colledge (1937) reported a case in which the tuberculous mass was in the lower half of the trachea. Tracheotomy was not sufficient to overcome the obstruction and eventually the trachea was successfully excised.

In the bronchi there may sometimes be seen small nodules in the mucosa or in the submucous tissue. They are obvious on bronchoscopic examination, and in these cases the mucosa takes on a bluish-grey appearance which is readily identified from the usual pink tinge of the bronchial lining membrane.

Chevalier Jackson has described this as a cyanotic change in the mucosa. The discoloration is typical of tuberculosis and the disease has been diagnosed on this point in the absence of other proof—the proof becoming available at a later stage in the investigation.

The third group is that in which tuberculous lymph nodes have invaded the wall of the bronchus and in an occasional case of the trachea. The infected node becomes attached to the wall of the air tube and proceeds to erode its way through the wall. In certain cases it causes the formation of masses of granulation tissue which project into the lumen and produce an example of the second group of tuberculous manifestation.

In other cases the lymph nodes pass bodily into the trachea or bronchus and cause very severe obstruction which may be fatal. An example of this is lodged in the museum of the Brompton Chest Hospital. The specimen shows a paratracheal node which ulcerated through the tracheal wall and fell on to the bifurcation, causing sudden death from asphyxia. The node can be seen lying in this position with the opening in the trachea still patent. Another case was that of a boy of nine with an asthmatoid wheeze. Bronchoscopic examination showed a granular mass projecting through the wall of the right main bronchus and almost closing its lumen. Removal of this mass through the bronchoscope abolished the wheeze, and histological examination of the tissue removed showed the structure of a tuberculous lymph node. A third case, in a middle-aged woman, presented signs of a blocked descending right bronchus and an atelectatic lower lobe. The X-ray appearance was very suggestive of carcinoma of the descending bronchus. Bronchoscopic examination revealed a granular mass, and when a portion was removed for microscopic investigation it was found to be gritty and calcareous. Further removal showed the mass to be a calcareous lymph node, and after its complete removal a considerable amount of pus was aspirated and the lobe eventually re-aerated.

The symptoms of these lesions vary according to the type and the site.

The ulcerative type in the trachea gives rise to a pain which may be felt along the course of the trachea or may be referred to a point behind the manubrium of the sternum. It is not as a rule a very severe pain, but it is aggravated by coughing. The cough occasioned by ulceration in the trachea is persistent and intractable and may be very severe. It is not controlled by any of the usual forms of treatment. If there is any œdematous swelling

around the ulceration, there may be an asthmatic wheeze or even some degree of dyspnœa.

In addition there is the persistence of tubercle bacilli in the sputum which is not explained by the condition of the lungs.

In the proliferative type where there are masses of granulation tissue projecting into the lumen, the symptoms become those of partial or complete obstruction.

Where the mass only partly obstructs the trachea or bronchus there will be a wheeze and some degree of dyspnœa. The cough is usually a less marked symptom in this type of tuberculosis than in the ulcerative type, though it may be troublesome.

Such a degree of obstruction does not of necessity cause any changes in the lung. Where, however, the mass of granulation tissue either blocks the lumen of one of the divisions of the bronchus completely, or acts as a check-valve, allowing egress but not ingress of air, a degree of atelectasis will result. The amount of lung which is de-aerated depends, of course, upon the site of the obstruction, whether in the main bronchus, above or below the upper or middle lobe bronchi, or whether it merely obstructs the secondary bronchus to one lobe or even to a part of a lobe. The accompanying signs and symptoms depend on the degree and extent of atelectasis.

The treatment of the local manifestations of tuberculosis varies according to their nature and site.

Local treatment of such lesions must of necessity be applied by endoscopic means. The fear of introducing a bronchoscope into a patient suffering from pulmonary phthisis has been largely discounted. It is found that such manipulation has no untoward effect on the majority of such patients.

Samson, however, while agreeing with this attitude, utters a warning against biopsy or partial removal of tuberculous tissue from the bronchus, because of the danger of dissemination or the activation of the pulmonary focus.

In the case of the tuberculous ulcer, treatment may be applied either by the galvanocautery, by diathermic coagulation, or by the application of chemical substances.

The galvanocautery produces good results but has certain disadvantages—its control at the distance of a long bronchoscopic tube is not easy and it does not cool off very rapidly after the current has been cut off, thereby causing more destruction than was intended. Diathermic coagulation is easier to control, and its results are equal to those of galvanocauterisation.

The application of 30 per cent. aqueous solution of silver nitrate has

produced a certain amount of success, and particularly in the more extensive ulcerations where granulation tissue is beginning to form. In the smaller ulcers, without much surrounding inflammation and œdema and without the formation of granulation tissue, the diathermy has given very good results, as described by Warren, Hammond and Tuttle.

Where a mass of granulation tissue or an eroding lymph node is presenting into the lumen of the trachea or bronchus, it is best treated by removal of the tissue with biopsy forceps and by application to the base of diathermy or of silver nitrate. In the writer's hands this manipulation has been followed by good results, and the same experience is described by Warren, Hammond and Tuttle.

These authors discuss the treatment of stenosis which results from the healing of tuberculous lesions. Where the stenosis is not causing any harm they leave well alone, recognising the possibility of stimulating the disease to further activity. Where definite obstruction is being caused it may be possible to remove portions of a stenotic band by means of punch forceps and cauterising the raw areas, preferably by diathermy. In cases of annular strictures some benefit may be obtained by active dilatation, but this must be done very gradually, as too rapid dilatation of a bronchus may be followed by a dangerous extension of the disease, or in some cases by a serious hæmorrhage.

Tuberculous tracheo-bronchitis is a serious complication of a disease that is often in an already advanced and dangerous stage and the eventual prognosis is necessarily bad. There is, however, a considerable proportion of cases on record which have recovered from the tracheal or bronchial lesion and in which the pulmonary condition has either healed or become inactive. The condition is far from hopeless and should be given the full benefit of the various methods of treatment.

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THE ÆTIOLOGY AND PATHOLOGY OF TUBERCULOUS EMPYEMA

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Introduction.

EMPYEMA occurring in association with phthisis was recognised by the Hippocratic School of Physicians, and its frequently fatal outcome was appreciated. Although Morgagni[1] and Laennec[2] described cases of tuberculous empyema, however, the specific nature of the infection was not realised until the identification of the tubercle bacillus by Robert Koch in 1882. Since this time clinicians have known that pure tuberculous empyema may arise in patients who have not previously been recognised as suffering from pulmonary tuberculosis. Diagnosis in these examples depends upon the identification of tubercle bacilli in pus obtained from the pleural cavity.

But all tuberculous pleural effusions are not purulent. Gloyne,[3] for instance, has shown that tubercle bacilli may be identified by ordinary staining methods in 40 per cent. of simple serous effusions. There must be some factor, therefore, which determines whether a tuberculous effusion is serous or purulent. Patterson[4] suggested that the dosage of bacilli infecting the pleural sac was the determining factor; though this may be so, experimental evidence has not so far supported this contention, for Corper and Rensch[5] and Lemon and Montgomery[6] were unable to produce uncontaminated purulent pleural effusions by simple tuberculous infection of the pleura. From clinical observation Fishberg[7] suspected that purulent effusions occurring in tuberculous patients were preceded by a latent pneumothorax. The importance of a clearer knowledge of the production of purulent tuberculous effusions needs no emphasis. Both prevention and treatment thereby stand to gain.

PLATE I

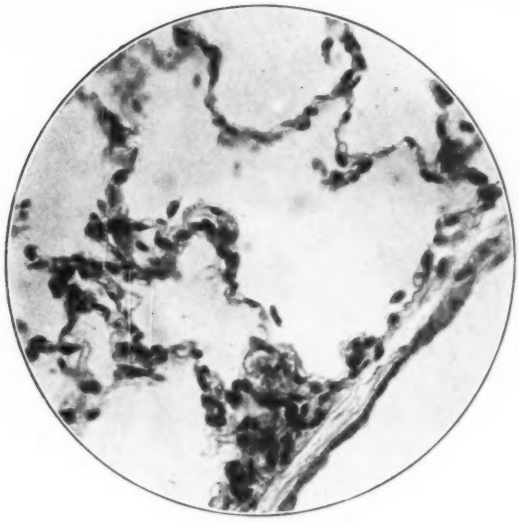

FIG. 1.—NORMAL PLEURA (×400).

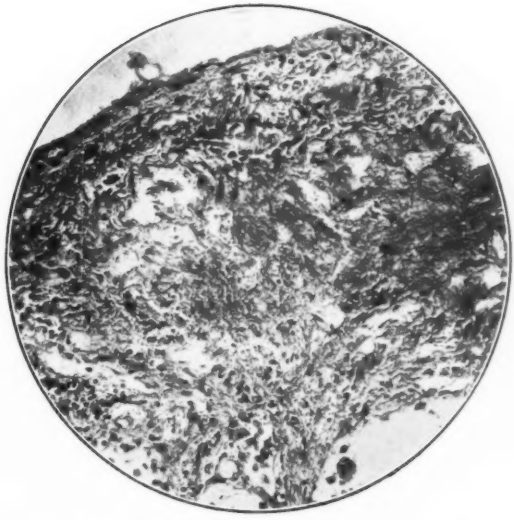

FIG. 2.—FIBROUS SUBPLEURAL NODULE IN MILIARY TUBERCULOSIS (×300).

[*To face page* 36.

UNIV. OF MICH.

Investigations.

This paper deals with an attempt to elucidate some of the factors responsible for the production of tuberculous empyemata. Two methods of approaching the problem were used. The first comprised a study of the pathology of the pleura in the presence of pulmonary tuberculosis, and also in the presence of pleural effusions of tuberculous origin. Such an investigation, of course, could only decide what structural features were constantly present in association with empyema, and not with effusions of other types; it was not expected that it would throw any direct light upon the factors which operate to produce empyema. The value of this investigation was rather to furnish collateral support for evidence obtained in other ways.

This second line of approach was the experimental production of tuberculous pleural effusions under varying conditions, correlating these with the subsequent findings at autopsy. It was thought that by selecting the experimental conditions, as the work progressed, a crucial series of investigations might be evolved.

A. The Morbid Anatomy of the Pleura in Pulmonary Tuberculosis and Empyema.—Macroscopic pleural thickening over the apex of the lung in association with pulmonary cavitation has been described since the time of Morgagni and Laennec; but little attention has been paid to the histopathology of the pleura in pulmonary tuberculosis apart from this. Davson and Susman[8] observed, during their study on silicosis, that the pleural layers frequently showed collagenous thickening of varying depths over healed tuberculous foci near the pleura. In the present study this thickening of the subserous layer of the pleura was invariably found even when the tuberculous focus did not encroach on the membrane.

The normal visceral pleura consists of three definite layers:

(*a*) A serous layer of endothelial cells.

(*b*) A subserous layer of fibroblasts arranged parallel to the surface.

(*c*) A zone of connective tissue which merges into the alveolar tissue.

Fig. 1 shows a typical example, taken from the lung of an infant who died from epidemic diarrhœa.

Specimens from the lungs showing various types of tuberculosis were obtained from 200 routine autopsies at the Austin Hospital, Melbourne. A detailed account of this work has already been published elsewhere.[9] The types of pleural involvement that were found may be summarised as follows:

1. In miliary tuberculosis, of which fifteen cases were examined, pleural effusion was present in one instance only, though tubercles were commonly seen to bulge into the pleura—an observation in accord with those of

Kaufmann.[10] When stained in sections the serous layer appeared normal, but in the subserous layer immediately over the tubercle a definite thickening of the fibroblast layer was constantly present (Fig. 2).

2. Tuberculous foci not immediately beneath the pleura did not always lead to macroscopic changes in the adjacent visceral membrane. Histological examination, however, showed that in all cases there was considerable thickening of the fibroblastic layer (Fig. 3), with the appearance of many capillaries. The serous cells remained normal.

3. Tuberculous cavities beneath the pleura were frequently associated with gross macroscopic pleural thickening (Fig. 4). Occasionally the cavity appeared to be separated from the pleural sac by a thin transparent membrane, but even here histological examination showed that the typical subserous reaction had taken place.

4. A serous pleural effusion arising during the course of artificial pneumothorax was accompanied by gross pleural change. Only one specimen could be obtained, but in this case a thin layer of lymph covered the pleural membrane, and beneath the serous layer was a thickening of the zone of fibroblasts, with dilation and engorgement of the capillaries (Fig. 5). There was no macroscopic evidence of any rupture in the visceral pleura.

5. Eleven cases of tuberculous empyema were examined, and in each there was a thick layer of lymph which was easily stripped from the surface of the pleura over the collapsed lung. In every case one or more tuberculous foci in the lung were found to have ruptured through the pleural membrane, and were communicating with the empyema sac. In addition, microscopic study showed that there was a marked subserous thickening in addition to the fibrosis in the empyema wall.

In all types of pulmonary tuberculosis examined a reaction had occurred in the subserous layer of the pleura, with a resultant increase in thickness. This reaction may well be a measure of defence. It is comparable to the thickening of the psoas fascia in the presence of psoas abscess; in the latter condition contiguous spread of infection to the peritoneal cavity is rare.

From the results of this study two conclusions appear to be warranted:

1. That the presence of tuberculous infection in the lung near the pleura provokes a pleural reaction with thickening of the subserosa.

2. That a tuberculous empyema is constantly associated with the rupture of an intrapulmonary focus through the visceral pleura. A direct spread of infection from the lung to the pleura must therefore occur.

B. Experimental Investigations.—The experimental procedures were directed to the production of tuberculous pleural effusions, with subsequent study of the morbid anatomy.

PLATE II

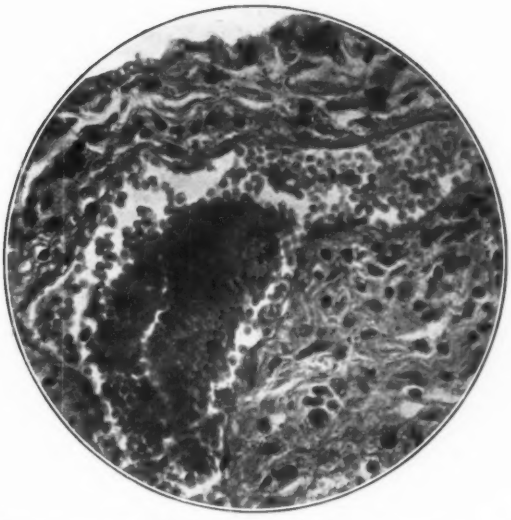

FIG. 3.—SUBPLEURAL THICKENING AND HYPERÆMIA OVER A TUBERCULOUS FOCUS NOT IMMEDIATELY BENEATH THE PLEURA (×400).

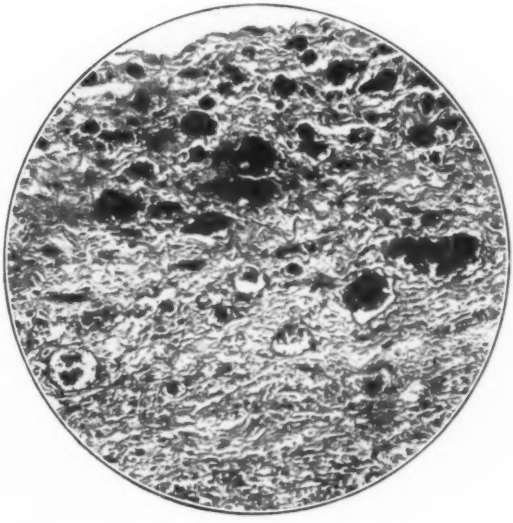

FIG. 4.—SUBPLEURAL THICKENING OVER A TUBERCULOUS CAVITY (×200).

[*To face page* 38.

UNIV. OF MICH.

Methods.—Male and female rabbits were used of an average weight of 4 to 5 kgs., and were obtained from the Walter and Eliza Hall Institute, Melbourne. The animals were kept in separate open cages, and none died of intercurrent infection during the course of the experiments. No pregnant animals were used.

The bovine strain of tubercle bacilli used in the experiments was obtained from the Bacteriology Department of the University of Melbourne, and was of such virulence that an intrapulmonary injection of 0·1 mg. of organisms in the normal animal caused death in three weeks. Sensitisation of certain animals was done by vaccination with 5 mg. of heat-killed organisms. Tytler,[11] Topley and Wilson,[12] and Rich and McCordock[13] have shown that the sensitivity thereby produced is comparable to that produced by living organisms. Sensitisation in this manner does not produce any lesions which might complicate the experimental procedures.

All animals were subjected to artificial pneumothorax during the course of the experiment, the pneumothorax being induced as in the human, using 20 c.c. of air at the induction. Refills were given twice weekly. The final intrapleural pressure was never raised above zero, and the pleura was at no time deliberately infected until the pneumothorax had been present for at least one week. The animals were inoculated with tubercle bacilli intrapleurally at the time of a refill. An average dose of 0·01 mg. was used. The presence of a pleural effusion was detected radiographically by screening in the erect position. Specimens of fluid were withdrawn at the times of inoculation, and the nature of the fluid observed macroscopically and after staining smears with Leishman's stain. All purulent fluids were examined by culture on blood agar slopes to exclude the presence of secondary infection; no contaminating organisms were found in any case. Fluids classified as opalescent were not purulent, as they did not contain numerous polymorphonuclear cells like those referred to as purulent.

The visceral pleura was traumatised by scratching the pleura with the point of a sterile needle. Blood used for intrapleural injections was in each case obtained from the animal by cardio-puncture; serological errors were thus excluded by using the animal's own blood.

Injections of bacilli into the lung beneath the visceral pleura were in each case made before the induction of pneumothorax, and the distance from the surface was gauged approximately by the depth of the needle point.

At death the sternum was removed and the thoracic viscera examined *in situ*, after which the thorax was hardened in formalin and further studied by macro- and microscopic section.

The procedures were carried out in two groups (Tables A and B), and were designed to demonstrate the results of tuberculous infection of a

pneumothorax space in animals with normal lungs, and also in animals with known tuberculous disease in the lungs prior to the induction of the pneumothorax. In addition, the subsequent effects of pleural trauma analogous to those accidents which may occur during artificial pneumothorax treatment were investigated. Non-sensitised and sensitised animals were used in both groups of experiments in order to determine the importance of tuberculin sensitivity in contributing to the results obtained.

The experiments and their results are summarised below in Tables A and B:

TABLE A.—EXPERIMENTS IN WHICH THE LUNG WAS NORMAL PRIOR TO THE INDUCTION OF PNEUMOTHORAX.

Experimental Procedure.	*Number of Animals.*	*Effusion—*			*Type of Effusion.*
		24 *Hours.*	72 *Hours.*	3 *Weeks.*	
Pneumothorax and pleural infection	*N 5	—	—	+	Serous.
	†S 5	+	+	+	Serous.
Pneumothorax and pleural infection and scratching pleura (trauma)	N 4	+	+	+	Opalescent.
	S 4	+	+	+	
Pneumothorax and pleural infection and 1 c.c. blood into pleura	N 2	+	+	+	Opalescent.
	S 2	+	+	+	
Pneumothorax and pleural infection and emulsion of caseous tissue injected into pleura	S 4	+	+	+	Opalescent.

TABLE B.—EXPERIMENTS IN WHICH PULMONARY TUBERCULOSIS WAS ESTABLISHED PRIOR TO THE INDUCTION OF PNEUMOTHORAX.

Experimental Procedure.	*Number of Animals.*	*Effusion—*			*Type of Effusion.*
		24 *Hours.*	72 *Hours.*	3 *Weeks.*	
Pneumothorax and pleural infection	N 5	+	+	—	Death.
	S 5	+	+	+	Opalescent.
Pneumothorax after many injections of bacilli just below visceral pleura	N 4	+	+	—	Serous.
	S 8	+	+	+	Purulent, 7. Serous, 1.

* N = Non-sensitised. † S = Sensitised.

In those animals which developed empyema the effusion was always blood-stained at first, and became frankly purulent within seventy-two hours. If the blood-stained fluid failed to appear the effusion remained serous throughout its course.

PLATE III

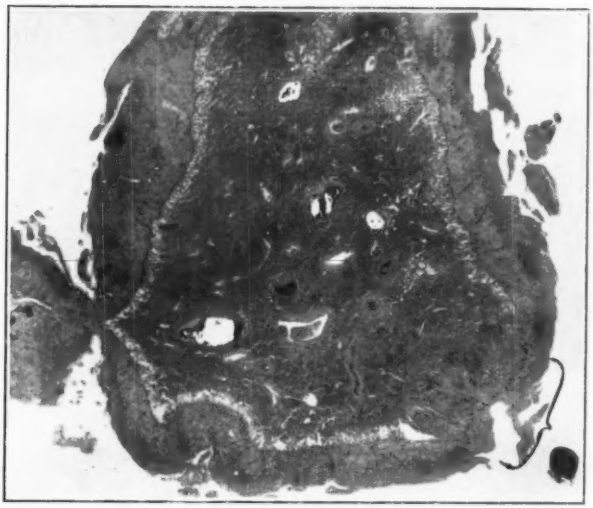

FIG. 5.—SUBPLEURAL HYPERÆMIA IN ASSOCIATION WITH A TUBERCULOUS SEROUS EFFUSION AND PNEUMOTHORAX (×100).

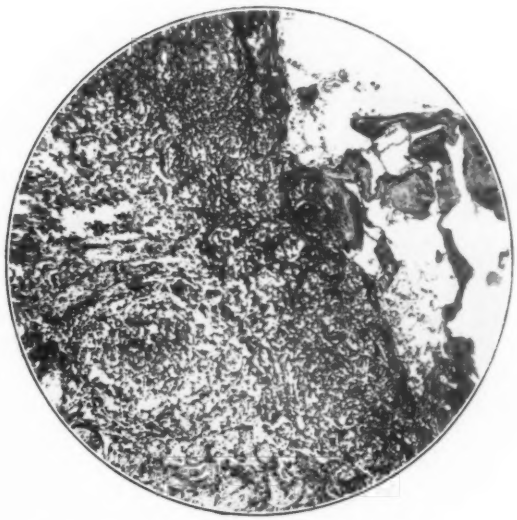

FIG. 6.—LOW-POWER PHOTOMICROGRAPH TO SHOW RUPTURE OF A SUBPLEURAL FOCUS IN EXPERIMENTAL EMPYEMA (×40).

[*To face page 40.*

UNIV. OF MICH.

In all those animals which developed empyemata there was microscopic evidence that an intrapulmonary tuberculous focus had ruptured through the visceral pleura (Fig. 6). Careful examination of those animals in which the effusion had remained serous showed that in no single instance was there any rupture of the pleura. In one animal of Group B where the effusion remained serous despite the procedure used, no rupture of the pleura could be found. It is important to observe that empyema appeared only in those animals which had been sensitised, and to correlate this observation with the fact that it was only in these animals that the intrapulmonary foci assumed the nature of well-localised lesions, and in the majority of cases proceeded to the formation of cavities.

These experiments therefore lead to the conclusion that a tuberculous empyema arises in the rabbit only if an intrapulmonary caseating tuberculous focus ruptures through the visceral pleura and infects a patent pleural sac by contiguity. As simple inoculation of tubercle bacilli into the pleural sac does not lead to empyema even in sensitised animals, it appears that there is some factor associated with the presence of caseous tuberculous material gaining access to a free pleural space which determines the formation of an empyema. What this factor is remains for further experiment to decide. Opie[14] suggested that biochemical changes due to enzyme action may be responsible.

Conclusions.

In a small series of cases of tuberculous empyema an easily demonstrable rupture of a caseating focus in the lung was invariably found at autopsy.

In an experimental study of the production of tuberculous pleural effusions in the rabbit it was found to be impossible to produce an empyema by simple inoculation of the pleural sac with tubercle bacilli even in a sensitised animal. Nor did subsequent trauma or pleural inoculation of whole blood lead to empyema. An empyema was obtained experimentally only when a caseating tuberculous focus extended from the lung to the pleura and ruptured. Apparently the presence of caseous material in a free pleural space is the necessary condition for the development of an empyema.

Experimental and pathological evidence is thus in accord and supports the belief that tuberculous empyema in man is the result of the rupture of a caseating tuberculous focus through the pleura.

I wish to thank Prof. P. MacCallum and Dr. R. D. Wright of the Pathology School, University of Melbourne, for their valuable advice and criticism in the course of this work; also the Trustees of the Pearson Fund, University of Melbourne, whose grant made this investigation possible.

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THE RÔLE OF ARTHRODESIS IN TUBERCULOSIS OF THE HIP-JOINT*

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The treatment of tuberculous arthritis of the hip-joint is essentially conservative in character. Rest, fixation of the joint, good food, open air, and other aids to improvement in the general condition of the body are all necessary, but whilst conservative treatment must remain the bulwark in our armamentarium, there are certain indications and clinical conditions which show the necessity for fixation of the joint by arthrodesis. These may be summarised as follows:

1. Old-standing disease in which there is increasing deformity.
2. Cases in which, after one or more periods of conservative treatment, there is recurrence of the disease, due time being allowed for the lesion to subside before operation is undertaken.
3. Persistent chronic pain in a joint which appears otherwise quiescent.

* From the Annual Report for 1936 on the Prevention and Treatment of Tuberculosis in the Administrative County of Lancaster.

Over a period of four and a half years 131 patients (76 adults and 55 children) have been admitted to Wrightington Hospital with tuberculosis of the hip-joint, and the operation has been performed in 11 cases (9 adults and 2 children)—*i.e.*, 8·4 per cent. of the total. It is most important that a careful selection of cases should be made, and it is our practice only to operate when the disease may be said to be reasonably quiescent; to operate when there is activity is definitely contra-indicated. In this series only two children were operated on; both were 14 years of age, and the disease had been present for seven years. In very young children such an extensive operation is never justifiable. Arthrodesis of the hip is not a life-saving measure; its purpose is the conversion of a weak, yielding ankylosis into a sound, immobile, painless fixation which will not yield to weight-bearing, and will not alter its angle at a later date.

In the table on page 44 particulars are given of the eleven patients upon whom the operation was performed.

From the table it will be seen that the combined operation of intra- and extra-articular arthrodesis has been done wherever possible. It has been found that the combined procedure does not unnecessarily prolong the time of the operation. It has the advantage of removing all the diseased tissue at the time of the operation, and if for any reason the extra-articular fixation is unsuccessful there is a possibility of a firm ankylosis following the approximation of the denuded femur and acetabulum.

The graft in every case was taken from the anterior part of the ilium. A large broad piece of the ilium was turned down and wedged into the upper part of the great trochanter. The lower part of the iliac graft before being turned down was not detached from the ilium; this is important, as the chances of the graft " taking " are considerably increased by adopting this method.

Eight of the eleven cases operated on healed by first intention; in three the wound broke down, and of these one ultimately died with multiple sinuses.

Nine cases showed a firm bony ankylosis in good position as a result of the operation; in one case the ankylosis was not absolutely firm, but the patient was working and suffered no disability; the case which died also showed a bony ankylosis in spite of severe suppuration.

Five cases are working at their normal occupation, three are fit for work but unemployed, one is doing domestic duties at home, and only one is unfit for work.

Patient, Age, Sex, and Occupation.	*Duration of Disease.*	*Indications for Operation.*	*Nature of Operation.*	*End Result.*
No. 1. F. V. T., male, aged 28, piecer in mill	5 years	Flexion and adduction deformity with subluxation of hip	Intra- and extra-articular arthrodesis	Firm ankylosis; working at normal occupation.
No. 2. W. C., male, aged 23, clogger	11 years	Severe flexion and adduction deformity	Intra- and extra-articular arthrodesis	Firm bony ankylosis; unemployed, but fit for work.
No. 3. P. M., female, aged 17, none	9 years	Flexion, adduction and internal rotation	Intra- and extra-articular arthrodesis	Firm bony ankylosis; fit for light work.
No. 4. M. B., female, aged 33, domestic	6 months	Early localised disease	Extra-articular arthrodesis	Firm ankylosis; fit for work.
No. 5. I. G., female, aged 14, scholar	8 years	Pain and recurrence of adduction deformity after transtrochanteric osteotomy	Intra- and extra-articular arthrodesis	Firm ankylosis; at school.
*No. 6. M. F., female, aged 22, weaver	7 years	Flexion and adduction deformity	Intra- and extra-articular arthrodesis	Firm ankylosis; doing domestic duties at home.
No. 7. B. S., female, aged 14, scholar	7 years	Increasing deformity and pain after using limb	Intra- and extra-articular arthrodesis	Firm ankylosis; at school and studying for scholarship.
No. 8. J. F. B., male, aged 22, farm labourer	1½ years	Persistent pain in spite of eighteen months' conservative treatment	Intra- and extra-articular arthrodesis	Died—multiple sinuses (graft had united with firm ankylosis).
No. 9. C. H., female, aged 23, paper-bag maker	6 years	Recurrence of pain with adduction deformity after several periods of conservative treatment	Intra- and extra-articular arthrodesis	Moderately firm ankylosis; working at normal occupation.
No. 10. W. B., female, aged 23, packer	9 years	Persistent pain when ambulant	Intra- and extra-articular arthrodesis	Firm ankylosis; working as packer.
No. 11. E. L., female, aged 21, weaver	2½ years	Unstable joint with mobility due to weak fibrous ankylosis	Extra-articular arthrodesis	Joint ankylosed, small healing sinus; not fit for work.

* See skiagrams.

PLATE IV

FIG. 1.—W. 3 (*a*) M. F., female, aged 22. Tuberculosis of right hip-joint. Skiagram taken before operation. (Note calcified debris above neck of femur and in region of great trochanter.)

FIG. 2.—W. 3 (*b*) Same patient. Skiagram taken after operation shows the graft as a firm boss of bone extending from the ilium to the great trochanter.

[*To face page* 44.

MAIN UNIV.

Summary.

1. Eleven cases are described in which the operation of arthrodesis of the hip has been performed.
2. In most of the cases the disease was of long standing—average duration over six years.
3. The operation is not justifiable in young children.
4. Both intra- and extra-articular arthrodesis should be done at the same time wherever possible.
5. Firm bony ankylosis in good position was obtained in ten cases.

I should like to acknowledge my indebtedness to Mr. T. P. McMurray, who performed most of the operations, for his kindly help and criticism.

A CASE OF ASBESTOSIS OF THE LUNGS

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J. R. BEAL,
M.D., D.P.H.,
Clinical Tuberculosis Officer, Sunderland,

AND

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M.D., CH.B., F.R.C.P.E., F.R.C.S.E., D.P.H.,
Pathologist, Royal Infirmary, Sunderland.

The relative longevity of asbestos cases is due to the well-known fact that pulmonary tuberculosis as a complicating factor occurs in a much smaller proportion of cases than in silicosis, and then only late in the disease as a rule. Wood and Gloyne (1934), dealing with a series of 100 cases, found twenty-one with active tuberculosis; and the same authors (1931), in a previous smaller series of fifty-seven cases, found, out of ten cases complicated by tuberculosis, that nine were in young females in whom there is normally a high incidence of pulmonary tuberculosis.

The case now described presented certain clinical and pathological points of interest, which perhaps excuse its addition to the now rather large number of reported examples.

CASE.—J. K., male, aged 44 years. This patient was first seen in August, 1936, when he was sent to one of us for investigation because of the possibility of his suffering from pulmonary tuberculosis.

He stated that he had had a cough since 1927 (nine years), which was becoming progressively worse and was associated with profuse expectoration. An increasing dyspnœa had recently become marked enough to appear on the slightest exertion, as on climbing stairs. For nine years he had been subject to recurrent attacks of pleuritic pain over the lower part of the left chest. In the twelve months before coming under observation he had lost 11 pounds in weight. There was no history of hæmoptysis or night sweats.

His previous medical history was unimportant except for "stomach trouble" that led to a period of hospital treatment in 1933, and for varicose ulceration of the right leg in 1935.

Occupational History.—The patient ceased work on account of chest trouble in April, 1931. For seventeen years—*i.e.*, since 1914—he had been employed in a chemical works handling asbestos. His particular work was to cut the asbestos into blocks, feed the crusher and pack into sacks. This type of work is one of the dustiest processes associated with asbestos manufacture. At no time did he use a respirator.

Clinical Examination.—The patient was well nourished. The chest was of an emphysematous type and expansion was markedly diminished. There was apical retraction, but the apices descended during inspiration and ascended during expiration. This was probably due to normal apices and diaphragmatic adhesions. The percussion note was impaired over the lower half of the chest posteriorly, more marked on the right side, and there was some increase of paravertebral dullness. The breath sounds were diminished over the lungs, but this was most noticeable over the bases. Crepitations were heard at the bases of both lungs, but most markedly at the left base. Clubbing of the fingers was pronounced.

Sputum examination was negative for tubercle bacilli on two occasions.

Radiological Examination (August 7, 1936) (Fig. 1) showed fibrosis in the middle and lower zones of both lungs, with numerous discrete nodules. The heart outline was indefinite, with increased density of the hilar shadows. There was enlargement of the broncho-pulmonary glands. No evidence of tuberculous infection was observed, and the opinion was given that the condition was one of pneumoconiosis of asbestosis type.

He was next seen eighteen months later. At this time the cough was much worse and dyspnœa was extreme. He had now obviously lost weight and was having profuse night sweats. The signs over the lungs posteriorly were unchanged, but at both apices the percussion note was impaired and

PLATE V

FIG. 1.

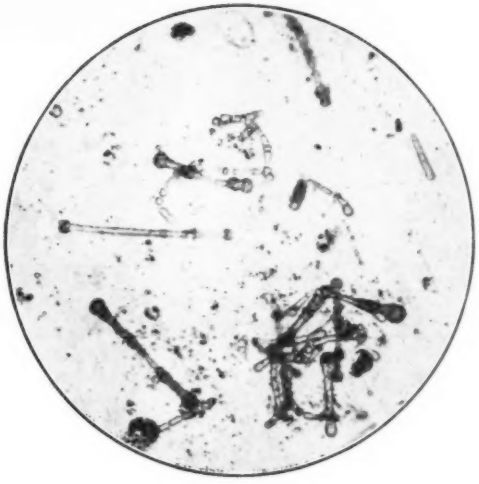

FIG. 2.

[*To face page 46.*

UNIV. OF MICH.

PLATE VI

FIG. 3.

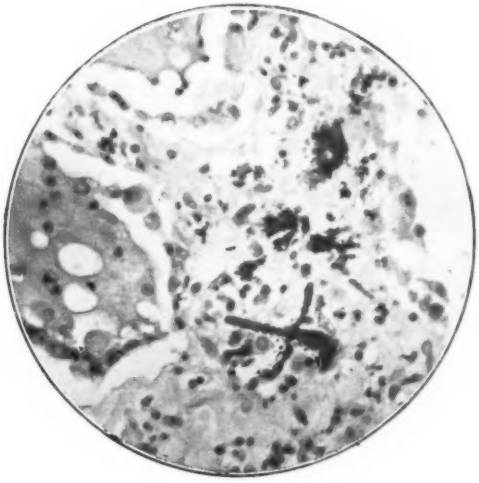

FIG. 4.

[*To follow Plate* V.

UNIV. OF MICH.

showers of fine crepitations were heard. Cyanosis was present. The sputum now showed tubercle bacilli to be present, and also asbestos bodies; the latter were found in considerable numbers, and often radially arranged (Fig. 2).

A further radiograph (March 4, 1938) (Fig. 3) showed consolidative changes now present in the right upper and middle zones in addition to the previous appearances. A diagnosis of pulmonary tuberculosis supervening upon pulmonary asbestosis was therefore established in this case. The patient progressively deteriorated and he died of heart failure seven weeks later.

The following is a synopsis of the post-mortem examination made on April 13, 1938:

External Examination.—The body was that of a middle-aged man. There was general œdema and very little subcutaneous fat. On the medial side of the right leg, at the junction of the lower and middle third, there was a varicose ulcer. There were no marks of injury. The teeth were scanty and carious.

Internal Examination.—The air passages showed some chronic bronchitis. There was about 10 to 12 ounces of clear fluid in each pleural cavity. Both pleuræ were greatly thickened, especially over the lower lobes and at the right apex. There were numerous and strong adhesions binding the lungs to the diaphragm. Both lungs showed very gross interstitial fibrosis with thickening of the interlobar septa. The right lung showed some tuberculous changes at the apex with a small cavity. There were also scattered tuberculous deposits in the left lung. In both lungs the deposits were relatively small and recent, with fibrosis mainly, and especially incident upon the lower lobes. Sections of lung showed asbestosis bodies (Fig. 4). There was excess of fluid in the pericardial sac. The right side of the heart was dilated and hypertrophied. The aorta and coronary vessels showed patchy degenerative changes. There was an area of fibrosis on the anterior wall of the left ventricle. The cardiac muscle showed toxic changes. The valves of the heart were not diseased. There was some free fluid in the abdomen. There were no tuberculous glands or other tuberculous lesions present. The stomach and intestines were healthy except for the duodenum, which showed some degree of duodenitis, chronic and acute. No ulcer was seen. The liver showed chronic venous congestion and a fine fibrosis. The spleen was somewhat enlarged and showed fibrosis. The bladder, prostate and testes were not diseased. The kidneys showed toxic nephritis, but no chronic changes were observed. The skull and scalp were healthy and uninjured. There was slight thickening of the pia arachnoid membrane and the basal vessels were degenerate.

Summary.

Clinically this patient was of interest, inasmuch as he was seen originally for an opinion concerning tuberculosis of the lungs. A diagnosis of occupational fibrosis was made at this time, but eighteen months later clear evidence of progressive pulmonary tuberculosis was also found. There was clinically a history of "stomach trouble" for some years, no doubt related to a duodenitis found at necropsy.

In regard to the significance of asbestos bodies in the diagnosis of asbestosis, Stewart and others (1932) regarded radially arranged bodies, as found in this patient, to be pathognomonic of the disease. Apart from this the mere finding of asbestos bodies cannot so be regarded.

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THE SPERO INDUSTRIES

THE provision of suitable employment for the tuberculous has been, and always will be, a difficult problem, owing to their limited capacity for work and the tendency of the disease to become active after periods of apparently complete arrest.

The fact that tuberculous patients could work under careful supervision was proved long ago by Marcus Paterson, who used graduated exercises as a definite therapeutic measure based on the theory of auto-inoculation. These exercises were prescribed with a totally different object from the occupational therapy with which they are often confused. The latter were devised for their psychological value, and from them have developed the industrial colonies such as Papworth and Preston Hall. The self-confidence which patients regain through occupational therapy in finding that they are still of some economic value and can produce marketable goods is most gratifying, and very often turns a morbid introspective man into a hopeful enthusiastic worker, which change reflects itself in a general improvement of his physical condition.

All schemes for training patients in suitable occupations at sanatoria are naturally very limited by the short duration of stay and only a comparatively few persons can be accommodated in colonies; therefore it has

PLATE VII

FIG. 1.—THE SPERO INDUSTRIES: VIEW OF WORKSHOP.

[*To face page 48.*

UNIV. OF MICH.

been thought necessary and advisable to develop schemes whereby patients can receive instruction in trades and handicrafts with a view to making them self-supporting by producing goods for which there is a continuous demand.

Many dispensaries have handicraft classes under the supervision of voluntary or paid instructors. Patients attend these according to their own inclination and are given suitable occupation for certain periods each week. But these organisations, although very creditable and valuable in themselves, hold little or no prospect to the patient of regular employment and economic independence except that to some extent the classes may be a connecting link between the sanatorium and future employment. To find this the patient must look to the Spero Industries, which are under the control of the Central Fund for the Industrial Welfare of Tuberculous Persons.

The Central Fund was founded in 1910 under the title " The Central Fund for the Promotion of the Dispensary System for the Prevention of Consumption in London," and co-ordinated the first eleven tuberculosis dispensaries in London on voluntary lines. These were transferred to their respective local boroughs in 1921. The committee, reconstituted and renamed as " The Central Fund for the Industrial Welfare of Tuberculous Persons," renewed its efforts for equally important work—*i.e.*, the provision of employment for the tuberculous living in their own homes, passed fit for light work, but incapable of competing in the open labour market.

Financial support came, and still comes, mainly from voluntary contributions assisted by grants from the Ministry of Labour, the British Legion and the London County Council. The organisation is controlled by a council of distinguished voluntary workers who have a keen interest in the welfare of tuberculous patients.

On January 1, 1923, a workshop for the manufacture of fancy leather goods was opened with six ex-Service men in Hatton Garden. This was transferred later to much more satisfactory and larger premises in Bolsover Street, St. Marylebone. In 1926 a firewood factory was established for the employment of the less skilled workman. This was started at Wicklow Street, King's Cross, and transferred in 1928 to 74, Paradise Street, Bermondsey. In 1932 a further venture was undertaken to provide occupational treatment for women by giving classes in glove making. All these three industries are still flourishing and giving patients an opportunity of securing work at a living wage, and in the case of the women the provision of pocket money for extra nourishment, etc.

Premises.—The Spero Leather Workshop is in a new modern building, and is designed with adequate ventilation, which also enables the workers to attain a maximum of sun and light. The stock room and office have the

same advantages, while a passenger lift and central heating contribute to the comfort of the employees. The Spero woodworkers' premises at Rotherhithe contain a central yard, uncovered, for the storage of timber, round which is grouped the saw shed and the choppers' and bundlers' department; also storage accommodation for the bundled firewood stock. The floor above is devoted to the new woodworking department, in which the latest modern machinery has recently been installed, and also the assembling shop. This factory has a canteen in which the men can have their meals in comfort.

The Glove Classes take place once a week in the Tuberculosis Dispensary's waiting rooms, where the accommodation, light and heating are provided free by the borough. A skilled instructor is engaged by the Central Fund Committee, and this body is entirely responsible for all the other expenses and for the sale of the gloves.

Selection of Patients.—Of the patients sent to sanatoria under the London County Council, some are selected whilst under treatment for occupational therapy in the workshops of these institutions. There they are instructed in elementary leather work and woodwork, and during this period their possible admission to the Spero Workshops on discharge is borne in mind. The Medical Superintendents observe the reaction of these patients to the treatment and training while under their care, and recommend those whom they consider suitable for vacancies as they occur. Applications are also received either from the Public Health Department or the local Tuberculosis Officers. The secretary and managers interview applicants and make the final recommendation to the committee.

Wage.—The trainees are started at a minimum wage of 30s. 3d. a week, although their economic value does not reach this figure for some considerable time. Increase of wage is given on merit and on recommendation by the managers. Promotion is slow, due to the physical condition of the trainee, who cannot be pressed to rapid production; also, in most cases, to the comparatively later age at which a new trade is being acquired.

The hours worked are as follows:

Spero Leather Workshop: 8 a.m. to 5.45 p.m.

Spero Wood Factory: 8 a.m. to 5 p.m.

A break of fifteen minutes is allowed both morning and afternoon for rest and refreshment.

Cocoa and milk is provided free every morning, and during the winter months each man is given a teaspoonful of cod-liver oil.

Other benefits include:

A Clothing Club and Holiday Club, to which the Central Fund contribute 1s. for the first shilling per week subscribed by the employee.

PLATE VIII

FIG. 2.—THE SPERO INDUSTRIES: VIEW OF WORKSHOP.

[*To face page* 50.

UNIV. OF MICH.

A fortnight's holiday a year on full pay; also payment for the Bank Holidays.

A Sick Benefit Scheme provides the equivalent to four weeks' wages, less 2d. in the shilling for temporary absences from sickness during the year.

An experienced manager is in charge of each workshop; also a skilled instructor.

The numbers employed in both workshops are approximately sixty to sixty-five men, a percentage always being absent through sickness for periods varying from a few days to several months.

There are usually fifteen to twenty women in the Glove Classes, some of whom stay only a short time until pronounced fit enough to take up regular work again.

The committee find increasing need to extend the activities of the workshops for the benefit of the many applicants waiting to be admitted, and never cease their efforts to seek new markets. It has just been decided to open, in the near future, a larger factory in which both the leather-workers and the woodworkers can be housed. This will be much more convenient from an administrative point of view, and will allow scope for considerable expansion of both industries in the future to the great benefit of an increased number of tuberculous persons.

The Spero Industries have made good progress and done valuable work for the past fifteen years. Many patients have been thankful for and have benefited by the opportunity to earn money. But, like all schemes for the employment of the tuberculous, it cannot be self-supporting, and its future expansion depends on adequate support combined with sound management.

It may be possible to link up the many creditable efforts by local authorities and After-Care Committees at present employing tuberculous individuals, and to develop a central organisation which would control the sales, production, and employment of patients over a wide area. Many tuberculous patients are capable of doing excellent work; moreover, the majority are very anxious to be employed.

It remains for us to supply the necessary financial assistance and the organisation to supply the facilities whereby these unfortunate people can prove their worth.

C. C.

CONSULTATION

CASE

By JAMES MAXWELL,
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Violet W., aged 20, a shop assistant in a London suburb, developed a sore throat on October 15, 1936. It appears to have been a very acute attack and the temperature soon after the onset rose to 103°. Three days later she developed a hard dry cough, and on October 20 she began to cough up a little sputum mixed with blood. In the following week the sputum was constantly streaked with blood and she occasionally coughed up dark red clots as well. The hæmoptysis was never profuse. At no time was there any complaint of pain in the chest. In addition she had the usual febrile symptoms, with headache, loss of appetite, occasional vomiting and constipation.

There was never any hæmorrhage from the other mucous membranes.

Apart from measles and mumps in childhood there was no history of any serious illness; the periods had always been regular and there had been no question of the use of any drug, such as pyramidon. The patient had not been subject to sore throats previously.

There was nothing relevant in the family history.

I was asked to see the patient by her family practitioner, Dr. B. Rai, on November 1, 1936. She appeared to be acutely ill, with pale mucous membranes, and marked fœtor oris was present. The temperature at this stage was 100·6°, the pulse 100, and the respirations 26 per minute. Examination of the mouth showed furring of the tongue and gross ulceration of the fauces; there was also considerable whitish exudate on the left tonsil. There were numerous lymphatic glands, about the size of an almond, in the anterior triangles of the neck, and smaller glands in the posterior triangles. These were freely movable and slightly tender.

There were no abnormal physical signs on examination of the respiratory tract and the heart appeared normal. On examination of the abdomen the

spleen was found to extend about one inch below the left costal margin. It was smooth and insensitive. The remainder of the physical examination was negative. No other enlarged glands were detected in any part of the body. The ocular fundi were normal.

In view of the absence of physical signs in the respiratory tract and the positive evidence of some disturbance of the lymphatic system, as shown by ulceration of the fauces, enlargement of the lymphatic glands and a palpable spleen, a provisional diagnosis of one of the acute diseases of the blood-forming organs was made, and the probabilities appeared to favour an acute leukæmia. The prognosis was necessarily very guarded, and it was decided that the patient should be admitted to St. Bartholomew's Hospital for further investigation.

On admission to hospital the following day the temperature was 100°, the pulse 120, and the respirations 28 per minute. A blood count was immediately done, and this showed:

R.B.C.	4,260,000 per c.mm.
W.B.C.	5,800 „ „
C.I.	0·94 „ „

Differential White Count

	Per cent.	*Per c.mm.*
Polymorphs	20	1,160
Lymphocytes, large	56	3,248
„ small	12	696
Large mononuclears	6	348
Eosinophils	2	116
Basophils	4	232

An X-ray of the chest was also taken at this time, and this showed an increase of the hilum shadows, especially on the left side, which appeared to be due to glandular enlargement. The remainder of the lung fields were normal.

Consideration of the evidence elicited at this stage supported the view that the condition was almost certainly a disease of the blood-forming organs, but the picture was by no means conclusive of leukæmia. A Paul Bunnell reaction for glandular fever was therefore carried out by Dr. H. F. Brewer, who reported that the serum showed the heterophil agglutinin for sheep's red cells to a titre of 1 in 1,024. Agglutination in so high a dilution is diagnostic of glandular fever, and therefore the diagnosis could be regarded as having been definitely established. It could be stated, in view of this, that the prognosis was good and the subsequent course of the illness justified this estimate. The temperature settled to normal on

November 4, and the throat condition cleared up within a few days. The spleen was not palpable on November 7, and two days later the last of the glands in the neck disappeared. The patient left hospital fully recovered on November 13.

Apart from an iron tonic in the recovery stage, no special treatment was given, nor did any appear to be necessary.

This case illustrates a rare difficulty in diagnosis, and it also shows how important it is to carry out complete investigations in order to establish an exact diagnosis and so to define the prognosis without waste of time.

In the first place the hæmoptysis, which was one of the prominent symptoms in this case, did not indicate disease of the respiratory tract, but rather a general disease of the blood-forming organs. In these cases the cause may be one, such as acute leukæmia, which is serious and almost inevitably fatal, or it may be a much less grave condition from which recovery is likely. Complete blood examination is absolutely essential in all such cases, and the specific reaction for glandular fever is of great value when the possibility of this diagnosis is being entertained. Hæmoptysis in glandular fever is extremely rare, but this case shows that the diagnosis must be considered in cases of hæmoptysis associated with enlargement of the spleen and lymphatic glands.

MEETINGS OF SOCIETIES

TUBERCULOSIS ASSOCIATION

THE first meeting for the session was held in London on Friday, November 18, the new President, Dr. G. T. Hebert, taking the chair. The subject of the Presidential address was "Fibrosis of the Lungs." This subject was chosen especially to stress the importance of combining the study of tuberculosis with that of non-tuberculous affections of the lungs. It also gave the speaker an opportunity of summarising the chief results and conclusions of an enquiry into the radiological diagnosis of fibrosis in which several members of the Association had helped. He would speak that evening chiefly of the non-tuberculous varieties, noting, incidentally, that in them, in contrast to tuberculosis, the fibrous tissue had a harmful effect, directly or indirectly causing disability, disablement, or even danger to life. After a brief historical survey of the ætiology of non-tuberculous fibrosis of the lungs, Dr. Hebert discussed its pathology. Pulmonary fibrosis could be divided into three types: (1) peribronchial, (2) interstitial or interlobular, (3) perifocal. Though all three types might be present together, one of them usually predominated. Thus chronic bronchitis was associated mainly with peribronchial, broncho-pneumonia with interstitial, and tuberculosis and silicosis with perifocal fibrosis. In peribronchial fibrosis the chronic inflammation caused the cilia of the bronchi to be shed and the mucous membrane to degenerate. Fibrous tissue was gradually laid down; the lymphatics and small blood-vessels were obliterated and the inner coats gradually destroyed, till the bronchus might even eventually be replaced by a fibrous tube lined by granulation tissue and ulcers. In interstitial fibrosis the interlobular septa were thickened by a vascular round-celled infiltration, with the formation and gradual contraction of fibrous tissue which compressed air-spaces, obliterated lymphatics and small bloodvessels, and exerted an outward pull on the bronchi. In perifocal fibrosis the fibrous tissue surrounded a caseous or silicotic core, ultimately forming a nodule in which no part of the original pulmonary structure remained.

The physical signs of interstitial fibrosis were due to changes in the physical properties of the lungs. Decrease in volume gave flattening of the chest-

wall and displacement of heart and trachea; decreased expansibility gave decreased expansion of chest and decreased air entry; increased density gave impairment of percussion note; and increased conductivity gave bronchial breathing, increased vocal resonance and fremitus, and caused crepitations to have a crackling, and rhonchi a creaking, quality. The signs of peribronchial fibrosis, on the other hand, were not distinctive, and its presence was to be inferred mainly from the history, together with signs of bronchitis and emphysema. Silicotic fibrosis, being of the perifocal and general interstitial types, was more recognisable than peribronchial fibrosis, but less so than the fibrosis of tuberculosis or of the chronic interstitial pneumonia of childhood. In the diagnosis of fibrosis the history and clinical examination were often sufficient. Radiology was liable to be misleading when films were read without a knowledge of the clinical condition of the patient and without serial examinations. There were three prevalent errors in the radiological diagnosis of tuberculosis: (1) Fibrosis was diagnosed much too freely. (2) A general fibrosis was not infrequently diagnosed in cases of chronic pulmonary catarrh from increase in the density or thickness of the pulmonary markings or from the presence of so-called " increased arborisation "—an appearance usually due to vascular engorgement or to vascular granular tissue. (3) There was often a failure to diagnose chronic interstitial pneumonia in the absence of positive shadows. On the other hand, positive shadows in any given film could not be ascribed with certainty to the presence of fibrous tissue, on radiological appearances alone, apart from cases of silicosis. Evidence of contraction would point strongly to fibrosis of the interstitial variety, collapse being the only other process causing contraction. Differential diagnosis between these two conditions would be made by serial radiography and by the history.

Dr. Hebert then described the test to which he had alluded earlier. Thirty films were selected from different patients, of whom ten had and twenty had not an appreciable degree of fibrosis as judged from a careful clinical and radiological assessment of each case. These films were shown to seventy clinical or radiological experts, each of whom was asked to state, with regard to each film, whether a specified form of fibrosis could be diagnosed confidently in some particular area or in certain instances in the lungs as a whole. Fibrosis was diagnosed when present in 57 per cent. of the replies, and when absent in 35 per cent. Omitting the replies on eleven " difficult " films—including cases of chronic interstitial pneumonia, bronchitis, clinical silicosis and asbestosis, miliary tuberculosis, amputation of breast, etc.—the respective percentages were 75 and 29. The figures did suggest that on the X-ray film fibrosis did not always

give recognisable evidence of its presence, and that at times even experts found it when it was not present, to a significant degree, usually through faulty interpretation of positive shadows. The results of the enquiry showed that the following theoretical considerations were applicable in practice: (1) Contraction of the lung, or of part of it, was good evidence of fibrosis if collapse could be ruled out. (2) Interstitial fibrosis, whether generalised or localised, should not be diagnosed on the evidence of linear shadows unless these were well marked or conformed to any type seen in silicosis. (3) Multiple nodular markings should be regarded as due to an inflammatory process unless they were sharply defined or of a type found in silicosis. (4) A generalised peribronchial fibrosis could rarely be distinguished with certainty from a chronic inflammatory process without fibrosis, but the presence of general emphysema was suggestive. (5) Neither density nor thickness of the wall of a round cavity could, in itself, be regarded as evidence of fibrosis. (6) Coarse linear bands, especially if in the neighbourhood of an interlobar fissure, as well as certain elongated shadows, were due more often to an exudative process than to fibrosis.

With regard, then, to the radiological diagnosis of the different forms of fibrosis, the conclusion could be reached that peribronchial fibrosis cast discrete rounded shadows, best seen in silicosis; that interstitial fibrosis, when generalised, cast linear shadows only when the fibrous tissue took the form of thick sheets or bands. When localised, there was radiological evidence of contraction, any linear or diffuse opacity that might be present being usually due to inflammatory change. Density and thickness of the wall of an annular shadow were not, in themselves, evidence of the presence of fibrosis. Finally, in peribronchial fibrosis, some of the thickening and increased density of the pulmonary markings might be due to fibrous tissue, but, as in other forms of fibrosis, accompanying inflammatory changes constituted the most probable source of the opacity.

In conclusion the speaker emphasised the outstanding value in diagnosis of the history of the case. Physical examination gave evidence of the interstitial types but not of the other two; while the rôle of the X-ray film was to show positive shadows wholly or partially due to perifocal fibrosis, and evidence of contraction in interstitial fibrosis.

At the evening session a paper was read by Dr. W. Burton Wood on "Epituberculosis." This term was introduced by Eliasberg and Neuland in 1920 to draw attention to a lung consolidation found in certain tuberculous infants. The term was intended only as a provisional title, implying tuberculosis *plus* something—the "something" being believed by them to be a non-specific exudation. Ranke's conception of the three stages

of tuberculosis was helpful provided it was only used as a scaffolding round which they could build their ideas. The first and second stages, unlike those of syphilis, proceeded almost simultaneously, and even the third stage might follow so quickly that the development of tertiary tuberculosis might be seen in quite a young child. The first and third stages need not detain them then; he would pass on to consider the second, or as he preferred to call it, the post-primary stage, of which the three dominating features were: (1) A tendency to exudative processes; (2) enlargement of glands around the bronchial trunks; and (3) the bronchial trauma which might thus be caused. The benign types of pulmonary tuberculosis, as found in a series of 90 cases collected over the last ten years, might be classified in four groups: (1) Hilar flares, 36 cases; epituberculosis, 18; pleural effusions, 31; chronic miliary tuberculosis, 5. This classification was based upon X-ray findings. Of these groups, pleural effusion, the most obviously exudative form, was usually mild in childhood, and might be entirely symptomless. In chronic miliary tuberculosis the individual stipples were slightly larger and softer than those seen in acute miliary tuberculosis, and they usually cleared rapidly. The hilar flare was the name given to triangular shadows of more or less uniform density and based on the hilum, usually on the right side. This was the commonest manifestation of pulmonary tuberculosis in childhood. No arbitrary division could, however, be made between this type and epituberculosis. Epituberculosis in process of devolution became a flare, and a flare in process of evolution might become epituberculosis—in fact, they might be termed major and minor epituberculosis. The history, clinical features, and laboratory tests had to decide whether such shadows were of tuberculous origin or not. The site was best determined by a lateral or sagittal view which showed the interlobar septa, avoided the superposition of lobes and revealed the retro-cardiac space and hilar area. A blur of this kind might be due to one of three causes: (1) A perifocal reaction round a primary focus near the hilum, in conjunction with the corresponding lymph glands and the reaction around them; (2) an area of tuberculous pneumonia, caseous or splenic, situated in the base of the upper lobe, the middle lobe, or the apex of the lower lobe; or (3) the commonest cause, the sequel, rather than the accompaniment, to primary infection. The evanescent nature of many of these shadows, the absence of scarring after resolution, and the frequent simultaneous appearance of other exudates, suggested that a raised tissue sensitiveness might be causing an exudative reaction around the root glands. Eighteen cases in the series of 90 could be classed as epituberculosis with a predominance of right middle lobe distribution. There were three possible explanations of the epituberculosis picture: (1) the lobar consolida-

tion might be due to a reaction of allergic type around a tuberculous focus; or (2) to a tuberculous pneumonia of benign type; or (3) the epituberculosis might be mainly due to pulmonary deflation following bronchial occlusion. The physical signs and clinical course were most consistent with the last explanation. Epituberculosis occurred at a period of the disease which was associated particularly with enlargement of bronchial glands, and at an age when the bronchi were easily compressible. It was rare in adolescence and never seen in later life. Bronchoscopic examination had shown that a caseous gland might ulcerate into a bronchus, block it, and cause local atelectasis. Post-mortem evidence of the correctness of the suggested explanation was obviously difficult to obtain in a disease which was rare and never fatal.

Dr. Burton Wood summarised his findings by saying that epituberculosis was a manifestation of post-primary tuberculosis in childhood, the chief factor in its production being atelectasis caused by compression of the bronchial glands. A secondary factor was probably exudation into the alveoli, as a result of lymph stasis and congestion. Tuberculous allergy also possibly played a part. If glandular caseation led to rupture of the wall of a bronchus, a caseous bronchitis or broncho-pneumonia might alter the clinical picture and lead to permanent damage of the lung. A failure of the collapsed lobe to re-expand must give rise later to bronchiectasis, which was a not uncommon result of tuberculous adenitis.

A short discussion took place after the reading of this paper. Dr. Lee Lander showed a number of slides to illustrate the part that atelectasis played in the changes seen. He agreed that all the evidence went to show that the factor involved was not non-specific inflammation. Dr. Andrew Morland spoke of a survey undertaken at University College Hospital of 500 students—a survey which had later been extended to include nurses. By this method they should learn a great deal about the early development of tuberculosis. Dr. M. O. Raven asked what was the cause of consistently high temperature met with in certain cases which he described. Mr. T. Holmes Sellors showed two cases of bronchiectasis following atelectasis due to pressure, pointing out the danger of accepting such cases as suitable for surgery. Lobectomy was contraindicated. Dr. Maurice Davidson paid a warm tribute to Dr. Burton Wood. He had that evening been finally convinced of the collapse theory of epituberculosis. The reduction of lung volume was also evidenced by the high negative pressures which Dr. Lee Lander had demonstrated. Dr. F. R. G. Heaf asked whether epituberculosis was found more often in girls than in boys. He doubted whether negative pressures necessarily indicated collapse. Dr. Alexander Capes referred to other conditions in which glandular enlargement was seen

in children. Dr. McDade said he had measured pleural pressures in many such cases and had found them mostly normal. Dr. G. A. M. Hall was convinced of the relation of atelectasis and epituberculosis, but looked upon it rather as a primary than a post-primary phenomenon. He also drew attention to the possible fallacy in reading films due to the practice of taking them in strongly forced inspiration. Dr. J. Watt thought it was hardly justifiable to retain the word "epituberculosis," as a large proportion of the appearances were due to bronchial destruction or to an allergic response. Dr. Vere Pearson, Dr. P. Ellman, and Dr. N. Lloyd Rusby each discussed a case. Another speaker said that among children coming up for examination as contacts at Brompton Hospital many showed evidence of epituberculosis.

Dr. Burton Wood, in reply, said that the cause of the high temperatures met with could not always be explained. With regard to the criticism of the term "post-primary," he pointed out that Ranke's conception had a basis of truth as a scaffolding, but there was no clear division between primary and post-primary. As to the frequency of epituberculosis, the condition was rare, but contact examination might show more such cases. The name "hilar flare" was simply to describe the radiological appearance of the triangular shadow in the hilar region; it had no anatomical, pathological, or ætiological connotation. Sanatorium treatment was not essential provided the home conditions were good.

JOINT TUBERCULOSIS COUNCIL

A MEETING of the Joint Tuberculosis Council was held at the rooms of the Society of Medical Officers of Health on Saturday, November 19, 1938. Dr. S. Vere Pearson (Mundesley) was in the chair, and twenty-two members were present.

The Chairman referred to the great loss which the Council had sustained through the deaths of Dr. L. S. T. Burrell and Dr. Jane Walker, both of whom had rendered valuable service to the Council almost since its inception.

A welcome to the Council was given to Dr. R. A. Young, who was elected by the National Association in place of Professor Lyle Cummins, recently resigned.

A request from the Secretary of the Tuberculosis Society of Scotland for representation on the Council was considered and the request acceded to: Dr. W. T. Munro (Glenlomond) will be the Scottish Society's representative on the Council.

The following were nominated to posts on the Council for 1939:

Chairman, Dr. S. Vere Pearson (Mundesley); Vice-Chairman, Dr. G.

Lissant Cox and Dr. D. A. Powell (Wales); Honorary Treasurer, Dr. G. Jessel (Lancashire); Honorary Auditor, Dr. D. P. Sutherland (Manchester); Honorary Secretary, Dr. J. B. McDougall (Kent).

Dr. G. Lissant Cox was able to report on a successful interview with the Ministry of Health regarding the republication of memorandum 131/T. The Council was informed that an entirely new memorandum would be drawn up at the Ministry, and that the Council would have a further opportunity of considering the memorandum in its final form.

A brief account was given to the Council on the interview which Dr. Lissant Cox, Dr. Esther Carling, and the Hon. Secretary had with the Interdepartmental Committee on Nursing Services.

Considerable discussion centred round the future policy of the Council on Post-Graduate Courses. Dr. F. Heaf, who has taken over temporarily, during the absence of Dr. Brand, the offices of Convener of these classes, reported on the success of the two most recent efforts—at Brompton Hospital and at Heatherwood Hospital. There was a general feeling amongst members that the Council's past record in Post-Graduate work must be maintained, and Dr. Heaf was asked to continue the organisation of the classes until such time as Dr. Brand had recovered from his illness. During 1939 some attention will no doubt be given to Post-Graduate classes on Tuberculosis for General Practitioners. It is hoped that a schedule for classes held under the auspices of the Joint Council will be available early in the New Year.

At the February, 1939, meeting of the Council, Dr. Jessel hopes to give the Council the results of the Radiology Committee's findings. He has been given valuable assistance by the co-option on his committee of Drs. Kerley, Sparks, Twining, and White. The report will be circulated prior to the next meeting of the Council.

Dr. C. O. Hawthorne brought to the notice of the Council his concern as to certain provisions in the Milk Bill now before Parliament. In his view, medical opinion had been to a large extent disregarded, and after some discussion he proposed that the Milk Committee be authorised to prepare a memorandum in keeping with the past policy of the Council—as previously minuted—and that this memorandum be circulated to Members of Parliament with the approval of the Chairman of the Council. To this the Council agreed unanimously.

Closer Co-operation between Organisations interested in Tuberculosis.

A motion was tabled dealing with this question, and Dr. R. A. Young expressed himself as being in hearty agreement with it. He spoke as a member of the Council of the National Association for the Prevention

of Tuberculosis, and he felt he was speaking on behalf of other medical members of the Association. Professor Jameson suggested that the following resolution should be put to the Council:

"That the time has come when the relationship of the National Association for the Prevention of Tuberculosis, the Joint Tuberculosis Council, and the Tuberculosis Association to one another should be discussed, and that the Joint Tuberculosis Council will be glad to appoint representatives to meet members of the other two bodies for this purpose."

Support for this was forthcoming from Drs. Ward and Heaf, and Dr. Jessel, whilst agreeing with the wording, emphasised the importance of the Council preserving its identity. It was resolved that the motion set out above be agreed to, and that the Chairman, Dr. Ward, Professor Jameson, the Hon. Treasurer, and the Secretary be representatives of the Joint Tuberculosis Council in such discussions as may take place.

Investigations.

A Sub-committee of the Council had prepared a list of subjects which might be suitable for investigation by the Council. This list included subjects as wide apart as "The Construction of Sanatoria with Special Reference to Capital Expenditure" and "The Relative Value of the Various Blood Tests in Tuberculosis." Some twelve subjects were in all suggested. In the final choice, however, the Council was influenced by a request from the Tuberculosis Group of the Society of Medical Officers of Health for guidance on the organisation of the Tuberculosis Service in time of National Emergency, and on the question of the infectivity of books in Public Libraries. An interesting discussion followed, and it was ultimately decided to investigate immediately "The Tuberculosis Service in Time of National Emergency," and "Whether the Use of Books in Public Libraries is a Source of Infection." Dr. James Watt (Godalming) and Professor Tytler (Wales) were appointed conveners of the two committees appointed to report.

Dr. R. A. Young was added to the Gold Committee, and the filling of the vacancy on the Council caused by the death of Dr. Jane Walker was deferred till next meeting, which will be held on February 18, 1939.

THE ANATOMICAL BASIS OF CAVITY HEALING

At a meeting held at the Sims Woodhead Memorial Laboratory, Papworth Village Settlement, on November 26, Dr. Walter Pagel gave a demonstration on the anatomical basis of cavity healing. He said that the subject deserves full attention, as only a few anatomical observations of healed cavities are

available and therefore the clinical deductions as to the factors allowing a cavity to disappear lack the necessary proof. (1) A cavity may heal by being converted into a bronchiectatic space, thereby becoming a part of the bronchial system. It is "healing of the cavity wall" rather than "healing of the cavity," as the space as such remains. The caseous wall gives place to ordinary granulation tissue in which a dense fibrotic ring develops which by its shrinking causes the size of the hole to be diminished considerably. The granulation tissue is finally epithelialised by bronchial epithelium and—histologically—the hole has the structure of a small bronchiectasis. The rôle of pleural thickening ("pleural cushions") in assisting the shrinking of the cavity by compression is doubtful. It is likely that it is the sequela to cavity shrinking rather than its cause. Two illustrative cases were shown:

(*a*) Male, 30. Large cavity in the left upper lobe. Two unsuccessful attempts at plombage; during operation anterior wall of the cavity torn. Formation of a sinus. Open treatment of the cavity, which considerably shrunk. No tubercle bacilli in sputum and sinus fluid. Death from embolism after selective thoracoplasty. A small bronchiectasis was found at the site of the cavity. Epithelialised granulation tissue covered the wall of the hole, in which no tuberculous structures were found.

(*b*) Female, 34. System of cavities in the right, large cavity in left upper lobe. Fibrosis in both upper lobes with shrinking of cavities followed up for eight years. Amyloid disease. Fatal pulmonary hæmorrhage. Small bronchiectatic partially epithelialised hole with thick fibrotic ring and pleural cushion in the right upper lobe was identified as one of the original cavities. Another cavity in the left upper lobe looked also like a bronchiectasis, but contained still caseous tissue with many tubercle bacilli.

(2) The cavity may entirely disappear and be substituted by a fibrotic scar. This will occur after complete elimination of tuberculous tissue and coalescence of the non-epithelialised fibrotic walls. Or the cavity may collapse, remnants of caseous tissue becoming inspissated, and the whole area being converted into an old caseous or calcifying nodule. Four illustrative cases were demonstrated (females aged 2, 25 and 7, and male aged 27; specimens kindly supplied by Dr. F. A. H. Simmonds, Clare Hall).

The high pressure found in cavities by S. Vere Pearson (1930) is the basic fact which suggests that they are much larger than the original area of tissue destruction, and that the fate of a cavity depends upon the air pressure and volume which has access to it from the draining bronchus.

It was suggested that bronchial plugging causes collapse of the surrounding tissue, and thereby collapse of the cavity. A caseous plug in the

bronchus, draining a cavity, was anatomically demonstrated for the first time and proof was given that bronchial plugging preceded the shrinking and disappearance of the cavity followed up in skiagrams (female, 25, three cavities which behaved differently under pneumothorax treatment. Cavity *a* erupted into the pleural cavity, causing fatal empyema; cavity *b* healed by conversion into a solid caseous focus; cavity *c* appeared enlarged in the skiagram, after pneumothorax, and showed a perifocal shadow of collapsed lung tissue. The shadow, together with the cavity, disappeared in the subsequent skiagrams. The specimen showed a small remnant of it with the surrounding lung tissue collapsed and the draining bronchus containing a caseous plug). In the discussion following the demonstration cases were shown and discussed by Drs. S. Vere Pearson, W. Paton Philip, F. A. H. Simmonds, G. G. Kayne, and A. S. Hall.

INTERNATIONAL PHYSICIANS' LUNCHEON CLUB

THE International Physicians' Luncheon Club of New York extends a most cordial invitation to physicians visiting New York to be honoured guests at an excellent international luncheon, at the same time offering the services of the Members of the Club for any information they may desire.

While guests are not requested to make speeches, any useful information they wish to give informally will be greatly appreciated as fostering medical progress and international goodwill among physicians from all over the world. Luncheon is served at the International Medical Centre, 135, East 55th Street, New York, every Tuesday punctually at 1 o'clock, and is over about 2 o'clock. Physicians are kindly requested to inform the Club of their presence not later than 9 a.m. Tuesday by telephoning Wickersham 2-7900, or writing International Physicians' Luncheon Club, 135, East 55th Street, New York.

This notice was received recently from our American colleague, Dr. A. L. Soren. We feel sure that there will be many who will wish to enjoy this kind hospitality when visiting New York.

OBITUARY

NOEL DEAN BARDSWELL

It is with the deepest regret that we record the death of Dr. Noel Dean Bardswell after a short illness. He will always be remembered by his very numerous friends and colleagues as an expert in the realm of tuberculosis and as a pioneer in the modern attack on the disease.

Noel Dean Bardswell was born on December 20, 1871, and he graduated from Edinburgh in 1895. During the following year he took over the work of a medical dispensary in the Old Kent Road district in order to study the sociological conditions of the working classes in London. At Sheffield, in 1899, he began his work on tuberculosis, organising at the Royal Infirmary what is believed to have been the first sanatorium for the industrial classes in this country. Particulars of this work were published in his book, "The Consumptive Working Man." From Sheffield he went to London, and for eighteen months worked at the Brompton Hospital under the late Sir James Kingston Fowler. During that time he became a member of the Royal Colleges of Physicians of London and Edinburgh, was awarded the Parking prize for original research by the Royal College of Physicians of Edinburgh, and was elected F.R.S. Edinburgh.

His next appointment was that of Medical Superintendent of the private sanatorium at Banchory. He organised and directed the work of that institution for eighteen months. In 1902 he took over the private sanatorium at Mundesley, Norfolk, and here, in addition, resumed his work on the treatment of the tuberculous working classes. He opened and managed a small sanatorium for the industrial classes at a fee of thirty shillings a week. In 1905 he was appointed Medical Superintendent of the new King Edward VII. Sanatorium at Midhurst, then nearing completion. He organised the sanatorium at Midhurst and held the chief post there until 1917. For his services in this connection he was made a Member of the Royal Victorian Order by King George V. in 1913. Whilst at Midhurst he was elected to the Fellowship of the Royal College of Physicians. Bardswell's connection with Midhurst did not cease when he removed to London, as he was subsequently elected a consultant physician to the sanatorium. He was also a consulting physician to the British Legion Settlement Sanatorium at Preston Hall, near Maidstone.

At Midhurst, Bardswell carried out important work on the ultimate fate of patients following sanatorium treatment, his findings being embodied in a Medical Research Council Report. In this he laid the foundation for the scientific study of after-histories of tuberculous patients. He stressed the great prognostic dividing line between cases of tuberculosis in which the tubercle bacillus has been demonstrated in the sputum and those in which this finding has been absent. He undertook extensive trials of treatment by means of tuberculin, but subsequently abandoned this method so far as pulmonary cases were concerned.

Bardswell remained a firm believer in the value of routine sanatorium treatment and he deprecated the modern tendency towards extended treatment in hospital, together with collapse therapy. His contention was that artificial pneumothorax and surgical methods of treatment were a great help to carefully selected cases, but he set himself firmly against their indiscriminate use. He disapproved of collapse therapy as a routine treatment for pulmonary tuberculosis, and he never ceased to stress the necessity for careful judgment and selection of suitable patients by a physician with long experience of all aspects of the disease.

After the Great War, in which he served as a Major in the R.A.M.C., chiefly at Palermo and in France, he was invited by the French authorities to advise on a proposal to establish an institution for the treatment of tuberculosis in France, as a gift from the British nation to the French nation. The Franco-British Colony at Sillery, near Paris, subsequently became one of the chief national institutions for the treatment of tuberculosis in France. Bardswell was largely responsible for working out this scheme, for selecting the site and planning the administration. The French Government acknowledged this valuable work by conferring upon him the medal "Reconnaissance Française" and the Légion d'Honneur, and appointing him a life-governor of the Colony and of the dispensary in Paris.

Later, as a member of the Astor Departmental Committee, as Medical Adviser to the London Insurance Committee, and subsequently as a Principal Assistant Medical Officer to the London County Council in charge of the clinical arrangements for the treatment of tuberculosis throughout the county, Bardswell occupied continuously a position in the vanguard of the fight against consumption in this country. Though a warm advocate of sanatorium treatment he realised fully its limitations, and this intensified his interest in social problems and conditions. He seldom returned from a sanatorium visit without a close interest in the economic and environmental problems of patients whom he had seen, and these problems he would then proceed to solve. His deep regard for after-care led to a very close co-operation with the sanatorium settlements at Papworth, Preston

Hall, and also at the Burrow Hill Colony for Youths and the Spero Workshops.

After retiring from the service of the London County Council in 1936 he was appointed by the National Association for the Prevention of Tuberculosis as a Medical Commissioner in Cyprus. There is little doubt that he was attracted to accept this task, arduous for a man of his years, not only by his keenness to unravel the problems of tuberculosis, but also by his lifelong interest in archæology and in humanity in general. He found Cyprus a fascinating field for his great energies, and he came to know and to understand the Cypriot and his problems surprisingly quickly. His Interim Report, recently published by the N.A.P.T., is accordingly a document of great sociological as well as medical value.

Bardswell was first and foremost a "good doctor." He made full use of modern scientific methods when necessary, but he was never at a loss in their absence. He was always enormously interested in the individual, and he never treated or advised patients without full regard for the human as well as the purely clinical aspects of their problems. It was this wide outlook and his deep knowledge and understanding of the working classes that made Bardswell one of the foremost medical administrators of his time. His catholic interest in his fellow-men extended far beyond the bounds of medicine; together with his wife he was a keen archæologist and had an expert knowledge of mediæval art.

To his widow and family will be extended the sympathies of all who knew him as a good friend or as a fine colleague. There will be a far wider circle who will wish to join in tribute to his memory.

REVIEWS OF NEW BOOKS

Tuberculosis in Cyprus. An Interim Report on its Incidence and Means of Control made under the Auspices of the National Association for the Prevention of Tuberculosis. By Noel Dean Bardswell, M.V.O., M.D., F.R.C.P., F.R.S.(Edin.). Adlard and Son, Ltd, 1937. Price 2s. 6d. Pp. 227.

The National Association were indeed fortunate in securing the services of the late Dr. Bardswell for their survey of the tuberculosis problem in Cyprus. He brought to his task a ripe and varied experience such as is the possession of few men, and the fruits of it are to be seen in his marshalling and presentation of the facts which he collected during his tours of the island.

On arrival in Cyprus in November, 1936, Dr. Bardswell, together with Nurse Commissioner Jays (without whose linguistic and administrative abilities the survey would have been impossible), set out to discover the actual amount and distribution of tuberculosis in different parts of the island. He had been led to believe, and the preliminary tour seemed to confirm, that the problem was a most formidable one, tuberculosis a veritable scourge and on the increase, and that to exercise any control over it was next to impossible. The Cypriots were said to go in great dread of the disease; and because of the ostracism which followed its recognition it was all too frequently concealed, so that the authorities calculated that the notifications represented perhaps a fourth of the true incidence. The enquiry presented many difficulties, such as the impossibility of approaching Turkish women in " purdah," transport, the illiteracy of the inhabitants and their quite indiscriminate use of names so that a case might be notified two or even three times under different names. Moreover, as Dr. Bardswell puts it, " Cyprus is a detached piece of Asia, not Europe." Cypriots are quite unreliable in their statements and given to gross exaggeration. Yet, in spite of what they had been led to expect, the Commissioners found the natives on the whole co-operative, and in fact accomplished much that would have been quite impossible in England, however discreet the attempt.

Three lines of enquiry were undertaken:

1. Conversations with representatives of all sections of the community.

2. An attempt was made to discover the present condition of all tuberculous cases known to the medical authorities.

3. Tuberculin testing of samples of the child population—the Moro Percutaneous method being adopted.

From the enquiry Dr. Bardswell found that the disease was uniformly distributed throughout the island, with possibly a slightly higher incidence in the towns than the villages. There was a prevailing low incidence of positive reactions in the tuberculin test, an average of 6·5 per cent. in 8,084 village children and 8·2 per cent. in 1,841 children drawn from the six chief towns. In the case of two villages the entire population (save a very few) was examined, and the figures obtained for tuberculous incidence

were in agreement with those obtained from other sources, the crude rate per 1,000 being about 2·4. Dr. Bardswell estimates the tuberculous mortality at about 2 per 1,000. The tuberculosis problem is, thus, not as grave as had been anticipated. Allowance had to be made for the Cypriot characteristic of exaggeration.

A number of interesting points come to light. The advent of tuberculosis is not a recent event in Cyprus, and it is frequently introduced from outside, as when a Cypriot contracts the disease in England and returns home to end his days. Bovine tubercle does not occur. An idea was prevalent amongst the natives, and not the most illiterate of them, that Dr. Bardswell and Nurse Jays enjoyed some special immunity from infection which they could extend to others in their company. The report contains many sidelights on the Cyprus scene which will make it of interest to medical and lay readers alike. No pains have been spared to make it complete as far as an interim report can be and the actual data are given as far as possible. Photographs and drawings are included illustrating various aspects of life and conditions in Cyprus.

Report of the Agricultural Research Council, October, 1935, to September, 1937. H.M. Stationery Office, 1938. Price 5s. 6d.

Research on tuberculosis covers a wide field, and not the least interesting part of the field is research on tuberculosis in cattle. The Report of the Agricultural Research Council for the period October, 1935, to September, 1937, has just been issued, and admirably summarises the work done in this field. The research work done falls under two main headings:

(1) Eradication of tuberculosis from herds of cattle by tuberculin testing, and the rearing of healthy stock; and—
(2) Attempts to produce immunity by vaccination.

It has repeatedly been demonstrated that herds free of tuberculosis can be established and maintained by regular testing, elimination of reactors, disinfection and isolation, and by rigorous testing and quarantine of newly introduced cattle.

It has been found that tuberculin made by growing tubercle bacilli on simple synthetic culture media is preferable to that made with broth on account of the higher specificity of the reactions and the greater accuracy with which they can be interpreted.

Experiments are being conducted with B.C.G. vaccine which should yield results in 1938 or 1939, and in order to test further the claims of Spahlinger he has been invited to provide a sufficient supply of his vaccine. Experiments have also been done which strongly suggest that infection in adolescent cattle occurs more commonly through the air passages than by the alimentary canal.

Dairy Research. Agricultural Research Council Report Series, No. 3. H.M. Stationery Office, 1938. Price 2s.

This volume is a review of recent progress in dairy research. It deals in detail with the programmes of the two National Institutes for Research

in Dairying at Shinfield, near Reading, and at Kirkhall, near Ayr, and also the work relating to dairy research carried out by the Division of Bacteriology and Immunology of the London School of Hygiene and Tropical Medicine, by the Glasgow and Edinburgh Colleges of Agriculture, and in the laboratories of United Dairies, Ltd. A wide range of subjects is included.

The experimental work on the control of bovine tuberculosis is discussed. The Hannah Dairy Research Institute in Scotland showed, from an experiment which lasted four years, that twenty out of thirty herds which were under control had been cleared of tuberculosis. This demonstration led to the voluntary spread of the eradication movement on a remarkable scale. Of special interest are the results reported from three separate centres of experiments designed to ascertain the relative value of raw and pasteurised milk for calves. There was no difference in the effect of the two types of milk either on growth rate or on the condition of the calves at the end of the experiment. But at post-mortem examination none of the calves fed on pasteurised milk showed tuberculosis, while lesions were found in 65 per cent. of those fed on raw milk. The phosphatase test for determining the efficiency of the process of pasteurisation has proved a valuable aid in the supervision of pasteurisation machinery. Work on the nutritive value of processed milks in comparison with that of the raw milk is now in progress at Shinfield Institute. A chapter in the report is devoted to the scientific work which influenced the framing of the recently revised Milk Designations Order.

Life and Living. Report of the Committee for the Care of the Jewish Tuberculous, 1913-1936. New York.

This little brochure describes the results of the twenty-one years' work of the Altro Workshops, a Jewish foundation for the rehabilitation of convalescent tuberculous patients that was inaugurated in 1914 in the Bronx district of New York. The organisation is confined to tailoring, and as all garments are sterilised before sale, " open " cases of tuberculosis are now admitted to employment. Between 1915 and 1924 66 per cent. of those admitted were well and working from six months to ten years after discharge; for the period 1925 to 1934 this figure had risen to 80 per cent. for all patients. The industrial rehabilitation service costs about £23 per case per year, and about £57 for subsidies to the family, a total cost which is modest for the results obtained. As Dr. Dublin points out in his contribution to this volume, a man of twenty to thirty has a potential earning value to his family of several thousand pounds at least; permanent, partial or total disability converts this asset into a dead loss, with the liability of his support, and often that of his family as well, to be faced by relatives or by the State. To this has often to be added the loss to industry of a trained man. With such facts coming to be realised, it is to be hoped that the purely business aspects of rehabilitation, apart from the humanitarian ones, will in time make sufficient appeal to lead to a much wider development of schemes such as the one reviewed here. The Altro Workshops have a secure place among the pioneers.